SR 68/SR 95 NORTH CORRIDOR PROFILE STUDY

SR 68: SR 95 NORTH TO US 93
SR 95 NORTH: CALIFORNIA STATE LINE (COLORADO RIVER) TO NEVADA STATE LINE (COLORADO RIVER)

ADOT WORK TASK NO. MPD-0041-17
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DRAFT REPORT: SOLUTION DEVELOPMENT, EVALUATION, AND PRIORITIZATION

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PREPARED FOR:

ARIZONA DEPARTMENT OF TRANSPORTATION

PREPARED BY:

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ACRONYMS & ABBREVIATIONS

AADT	Average Annual Daily Traffic
ABISS	Arizona Bridge Information and Storage System
ADOT	Arizona Department of Transportation
AGFD	Arizona Game and Fish Department
ASLD	Arizona State Land Department
AZTDM	Arizona Statewide Travel Demand Model
BLM	Bureau of Land Management
BQAZ	Building a Quality Arizona
CCTV	Closed Circuit Television
CR	Cracking Rating
DCR	Design Concept Report
DMS	Dynamic Message Sign
FHWA	Federal Highway Administration
FY	Fiscal Year
HCRS	Highway Condition Reporting System
HERE	Real time traffic conditions database produced by American Digital Cartography Inc.
HPMS	Highway Performance Monitoring System
I-	Interstate
IRI	International Roughness Index
ITS	Intelligent Transportation System
LCCA	Life-Cycle Cost Analysis
LOS	Level of Service
LRTP	Long-Range Transportation Plan
MAP-21	Moving Ahead for Progress in the 21st Century
MP	Milepost
MPD	Multimodal Planning Division
NB	Northbound
NPV	Net Present Value
OP	Overpass
P2P	Planning-to-Programming
PA	Project Assessment
PARA	Planning Assistance for Rural Areas
PDI	Pavement Distress Index
PES	Performance Effectiveness Score
PSR	Pavement Serviceability Rating
PTI	Planning Time Index
RTP	Regional Transportation Plan
RWIS	Road Weather Information System
SATS	Small Area Transportation Study
SB	Southbound
SERI	Species of Economic and Recreational Importance
SHSP	Strategic Highway Safety Plan
SOV	Single Occupancy Vehicle
SR	State Route
TAC	Technical Advisory Committee
TI	Traffic Interchange
TIP	Transportation Improvement Plan
TPTI	Truck Planning Time Index
TTI	Travel Time Index
TTTI	Truck Travel Time Index
UP	Underpass
USDOT	United States Department of Transportation
V/C	Volume-to-Capacity Ratio
VMT	Vehicle-Miles Travelled
WACOG	Western Arizona Council of Governments
WIM	Weigh-in-Motion

1.0 INTRODUCTION

The Arizona Department of Transportation (ADOT) is the lead agency for this Corridor Profile Study (CPS) of State Route 68 (SR 68) from State Route 95 (SR 95) North to US 93 and of SR 95 North from the California State Line (Colorado River) to the Nevada State Line (Colorado River). The study examines key performance measures relative to the SR 68/SR 95 North corridor, and the results of this performance evaluation are used to identify potential strategic improvements. The intent of the corridor profile program, and of ADOT's Planning-to-Programming (P2P) process, is to conduct performance-based planning to identify areas of need and make the most efficient use of available funding to provide an efficient transportation network.

ADOT has already conducted eleven CPS within three separate groupings or rounds.

The fourth round (Round 4) of studies began in Spring 2017, and includes:

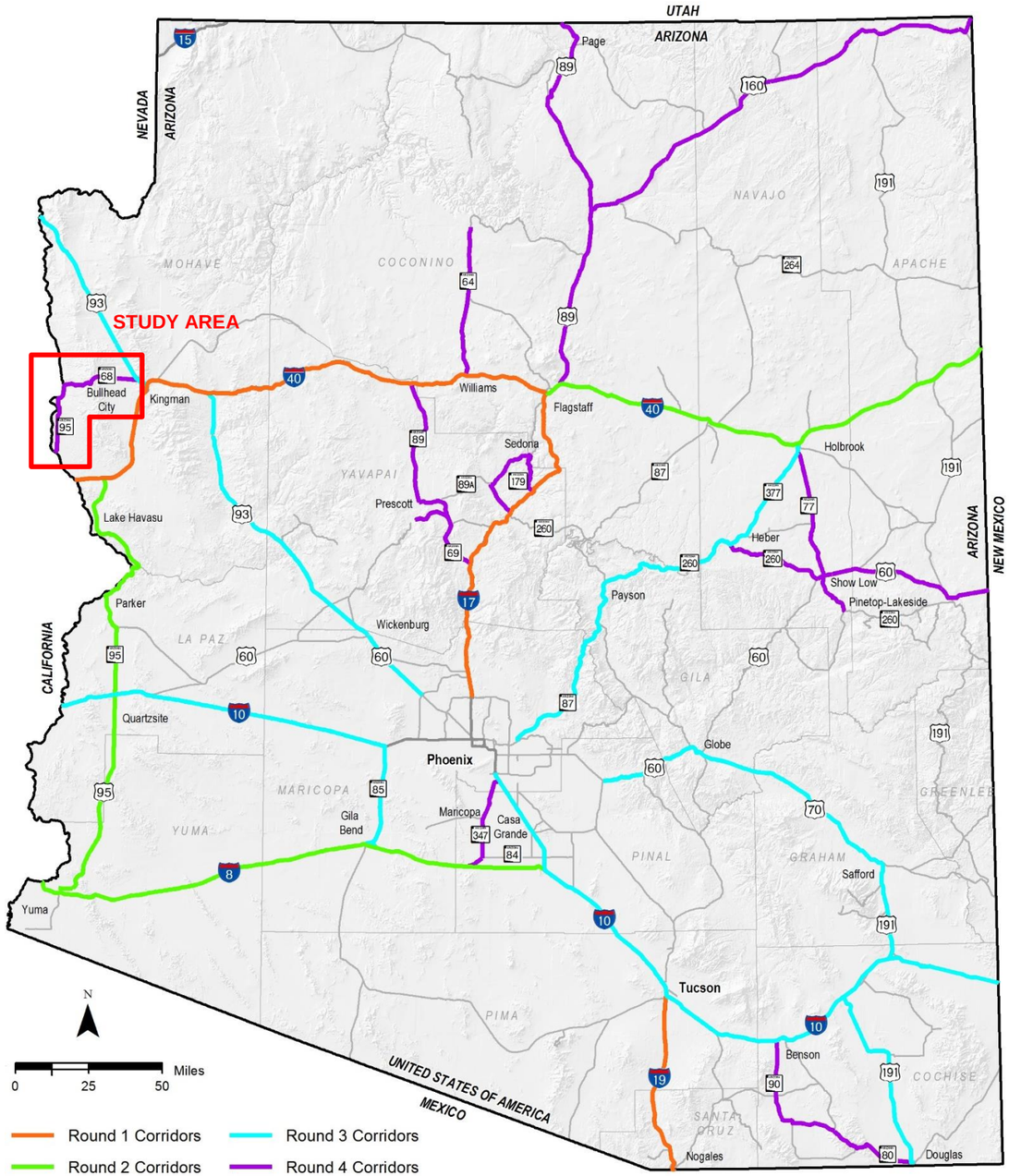
- SR 69/SR 89: I-17 to I-40
- US 89: I-40 to Utah State Line
- SR 64: I-40 to Grand Canyon National Park
- SR 179/SR 89A/SR 260: I-17 (Camp Verde) to I-17 (Montezuma Well Road)
- SR 347/SR 84: I-10 to I-8
- SR 260: SR 277 to SR 73; US 60: SR 260 to New Mexico State Line
- SR 77: US 60 to SR 377
- SR 68/SR 95 North: US 93 to California State Line
- US 160: US 89 to New Mexico State Line
- SR 90/SR 80: I-10 to US 191

The studies under this program assess the overall health, or performance, of the state's strategic highways. The CPS will identify candidate solutions for consideration in the Multimodal Planning Division's (MPD) P2P project prioritization process, providing information to guide corridor-specific project selection and programming decisions.

The SR 68/SR 95 North corridor, depicted in **Figure 1** along with the previous three rounds corridors**,** is one of the strategic statewide corridors identified and the subject of this Round 4 CPS.

The term "North" is appended to the name of the SR 95 section of the corridor to indicate this Round 4 CPS pertains to SR 95 north of I-40. This distinguishes it from the SR 95 (South) CPS conducted in Round 2 for SR 95 south of I-40.

Figure 1: Corridor Study Area



1.1 Corridor Overview and Location

The SR 68/SR 95 North corridor between the California State Line and US 93 provides movement for freight, tourism, and recreation needs within northwestern Arizona. The corridor connects Bullhead City, the Fort Mojave Indian Reservation, and Golden Valley along with other smaller communities. This corridor also serves a number of recreational and historic areas in northwest Arizona. The SR 68/SR 95 North corridor is approximately 51 miles in length.

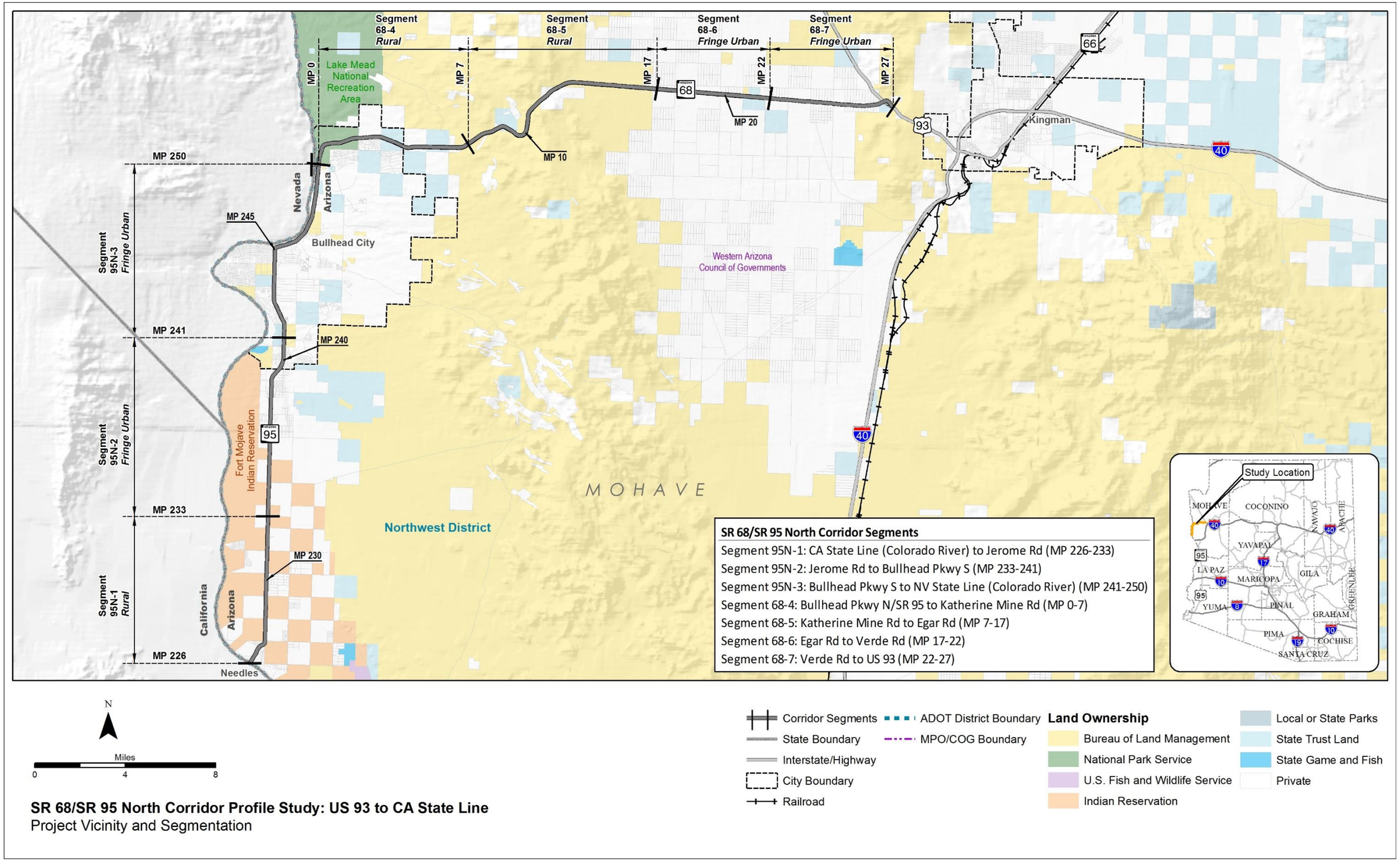
1.2 Corridor Segments

The SR 68/SR 95 North corridor is divided into 7 planning segments to allow for an appropriate level of detailed needs analysis, performance evaluation, and comparison between different segments of the corridor. The corridor is segmented at logical breaks where the context changes due to differences in characteristics such as terrain, daily traffic volumes, or roadway typical sections. Corridor segments are described in **Table 1** and shown in **Figure 2**.

Table 1: SR 68/SR 95 North Corridor Segments

Segment #	Route	Begin	End	Approx. Begin Milepost	Approx. End Milepost	Approx. Length (miles)	Typical Through Lanes (NB/EB, SB/WB)	2015/2035 Average Annual Daily Traffic Volume (vpd)	Character Description
95N-1	SR 95 North	California State Line (Colorado River)	Jerome Road	226	233	7	1,1 2,2	13,000/25,000	This rural segment has interrupted flow, numerous access points, level terrain, and is generally comprised of a four-lane undivided section. From the CA border to Courtwright Rd the roadway is a two-lane roadway (approximately 1.4 miles) and from Laguna Dr to King St the roadway has a five-lane undivided section (approximately 2.0 miles), and. There are four traffic signals located in this segment at the Courtwright Rd, Laguna Rd, Willow Dr, and King St intersections. This segment traverses the communities of Willow Valley, Arizona Village, and the Fort Mojave Indian Reservation.
95N-2	SR 95 North	Jerome Road	Bullhead Parkway South	233	241	8	2,2	24,000/38,000	This fringe urban segment has interrupted flow, numerous access points, level terrain, and is comprised of a five-lane undivided section located in the Fort Mojave Indian Reservation area. There are nine traffic signals located in this segment at the Boundary Cone Rd, Fairway Village Blvd, Lipan Blvd, Joy Ln, El Rodeo Rd, Aztec Rd, Camp Mohave Rd, Long Ave, and Bullhead Parkway South intersections.
95N-3	SR 95 North	Bullhead Parkway South	Nevada State Line (Colorado River)	241	250	9	2,2	28,000/42,000	This fringe urban segment has interrupted flow, numerous access points, level terrain, and is comprised of a five-lane undivided section located in the Bullhead City area. There are 18 traffic signals located in this segment – including one pedestrian hybrid beacon near 5th St – with designated left-turn lanes at the signalized intersections.
68-4	SR 68	Bullhead Parkway North/SR 95 North	Katherine Mine Road	0	7	7	2,2	10,000/17,000	This rural segment has interrupted flow, few access points, mountainous terrain, and is comprised of a four-lane divided section. There are two traffic signals located in this segment at the Bullhead Parkway North and McCormick Blvd intersections.
68-5	SR 68	Katherine Mine Road	Egar Road	7	17	10	2,2	8,000/10,000	This rural segment has uninterrupted flow, few access points, mountainous terrain, a curvy alignment, and is comprised of a four-lane divided section.
68-6	SR 68	Egar Road	Verde Road	17	22	5	2,2	9,000/11,000	This fringe urban segment has uninterrupted flow, numerous access points, level terrain, and is comprised of a four-lane divided section.
68-7	SR 68	Verde Road	US 93	22	27	5	2,2	11,000/12,000	This fringe urban segment has uninterrupted flow, numerous access points, level terrain, and is comprised of a five-lane undivided section located in the Golden Valley area.

Figure 2: Corridor Location and Segments



SR 68/SR 95 North Corridor Profile Study: US 93 to CA State Line
Project Vicinity and Segmentation

2.0 CORRIDOR PERFORMANCE

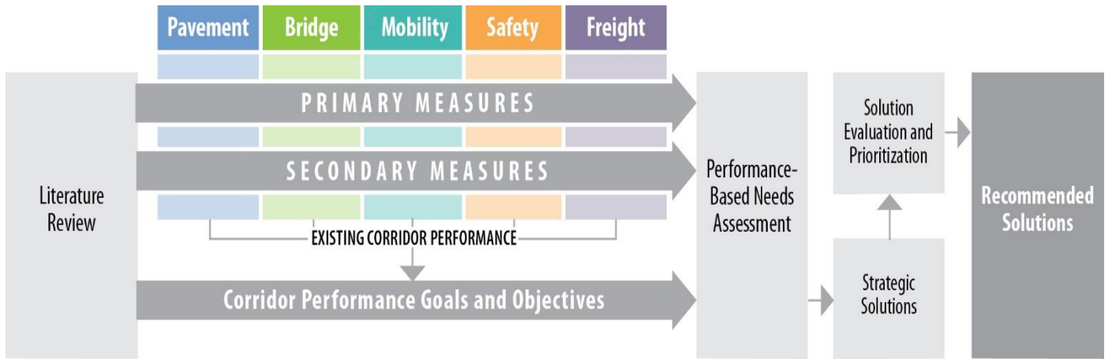
A series of performance measures is used to assess the corridor. The results of the performance evaluation are used to define corridor needs relative to the long-term goals and objectives for the corridor.

2.1 Corridor Performance Framework

This study uses a performance-based process to define baseline corridor performance, diagnose corridor needs, develop corridor solutions, and prioritize strategic corridor investments. In support of this objective, a framework for the performance-based process was developed through a collaborative process involving ADOT and the CPS consultant teams.

Figure 3 illustrates the performance framework, which includes a two-tiered system of performance measures (primary and secondary) to evaluate baseline performance.

Figure 3: Corridor Profile Performance Framework



The following five performance areas guide the performance-based corridor analyses:

- Pavement
- Bridge
- Mobility
- Safety
- Freight

The performance measures include five primary measures: Pavement Index, Bridge Index, Mobility Index, Safety Index, and Freight Index. Additionally, a set of secondary performance measures provides for a more detailed analysis of corridor performance. **Table 2** provides the complete list of primary and secondary performance measures for each of the five performance areas.

Table 2: Corridor Performance Measures

Performance Area	Primary Measure	Secondary Measures
Pavement	**Pavement Index** Based on a combination of International Roughness Index and cracking	• Directional Pavement Serviceability • Pavement Failure • Pavement Hot Spots
Bridge	**Bridge Index** Based on lowest of deck, substructure, superstructure and structural evaluation rating	• Bridge Sufficiency • Functionally Obsolete Bridges • Bridge Rating • Bridge Hot Spots
Mobility	**Mobility Index** Based on combination of existing and future daily volume-to-capacity ratios	• Future Congestion • Peak Congestion • Travel Time Reliability • Multimodal Opportunities
Safety	**Safety Index** Based on frequency of fatal and incapacitating injury crashes	• Directional Safety Index • Strategic Highway Safety Plan Emphasis Areas • Crash Unit Types • Safety Hot Spots
Freight	**Freight Index** Based on bi-directional truck planning time index	• Recurring Delay • Non-Recurring Delay • Closure Duration • Bridge Vertical Clearance • Bridge Vertical Clearance Hot Spots

Each of the primary and secondary performance measures is comprised of one or more quantifiable indicators. A three-level scale was developed to standardize the performance scale across the five performance areas, with numerical thresholds specific to each performance measure:

Good/Above Average Performance – Rating is above the identified desirable/average range

Fair/Average Performance – Rating is within the identified desirable/average range

Poor/Below Average Performance – Rating is below the identified desirable/average range

2.2 Corridor Performance Summary

The following general observations were made related to the performance of the SR 68/SR 95 North corridor:

- Overall Performance: The Pavement and Bridge performance areas show generally “good” or “fair” performance; the Safety performance area shows generally “below average” performance; the Mobility and Freight performance areas show a mix of “good”, “fair”, and “poor” performance
- Pavement Performance: The weighted average of the Pavement Index shows “good” overall performance for the SR 68/SR 95 North corridor; Segments 95N-1, 95N-2 and 95N-3 show “poor” or “fair” performance for all Pavement performance area measures
- Bridge Performance: The weighted average of the Bridge Index shows “fair” overall performance for the SR 68/SR 95 North corridor; Segment 95N-1 shows “poor” performance for the Bridge Index and the Lowest Bridge Rating measures; Segment 95N-3 shows “poor” performance for the Sufficiency Rating and % of Deck Area on Functionally Obsolete Bridges measures; Segment 95N-2 contains no bridges
- Mobility Performance: The weighted average of the Mobility Index shows “fair” overall performance for the SR 68/SR 95 North corridor; Segments 95N-1, 95N-2, and 95N-3 show “poor” or “fair” performance for the Mobility Index, Future Daily V/C, and % Bicycle Accommodation measures; Segment 95N-1 shows “poor” performance for the Existing Peak Hour V/C measure; all segments show “fair” or “poor” performance for the Closure Extent measure in at least one direction; Segments 95N-3 and 68-5 show “poor” performance for the Directional PTI measure in the NB/EB direction
- Safety Performance: The weighted average of the Safety Index shows “below average” overall performance for the SR 68/SR 95 North corridor; in the 2011-2015 analysis period, there were 39 fatal crashes and 114 incapacitating injury crashes; all segments except Segment 95N-1 show “below average” performance for the Safety Index in one or both directions; segments with “below average” performance on secondary safety performance measures are Segment 68-4 for crashes involving SHSP Top 5 Emphasis Areas, Segment 68-5 for crashes involving motorcycles, and Segments 95N-1, 95N-3, 68-4, 68-6, and 68-7 for crashes involving non-motorized travelers; there was “insufficient data” for crashes involving trucks, meaning there was not enough data available to generate reliable performance ratings so no values were calculated
- Freight Performance: The weighted average of the Freight Index shows “fair” overall performance for the SR 68/SR 95 North corridor; Segments 95N-3, 68-5, and 68-6 show “poor” performance for the Directional PTI measure in one or both directions; Segments 95N-2 and 68-6 show “poor” performance for the Closure Duration measure in one direction; there are no underpasses on the corridor so there are no vertical clearance restrictions
- Lowest Performing Segments: Segments 95N-2 and 95N-3 show “poor/below average” performance for many performance measures
- Highest Performing Segments: Segments 68-4 and 68-7 show “good/above average” performance for many performance measures

Figure 4 shows the percentage of the SR 68/SR 95 North corridor that rates either “good/above average” performance, “fair/average” performance, or “poor/below average” performance for each primary measure. On the SR 68/SR 95 North corridor, Safety is the lowest performing area with 73% of the corridor having “below average” performance as it relates to the primary measure. Pavement is the highest performing area on the SR 68/SR 95 North corridor with 53% of the corridor having “good” performance as it relates to the primary measure. The Bridge performance area generally has “fair” performance. The Mobility and Freight performance areas show a more even mix of “good”, “fair” and “poor” performance.

Table 3 shows a summary of corridor performance for all primary measures and secondary measure indicators for the SR 68/SR 95 North corridor. A weighted corridor average rating (based on the length of the segment) was calculated for each primary and secondary measure.

Figure 4: Performance Summary by Primary Measure

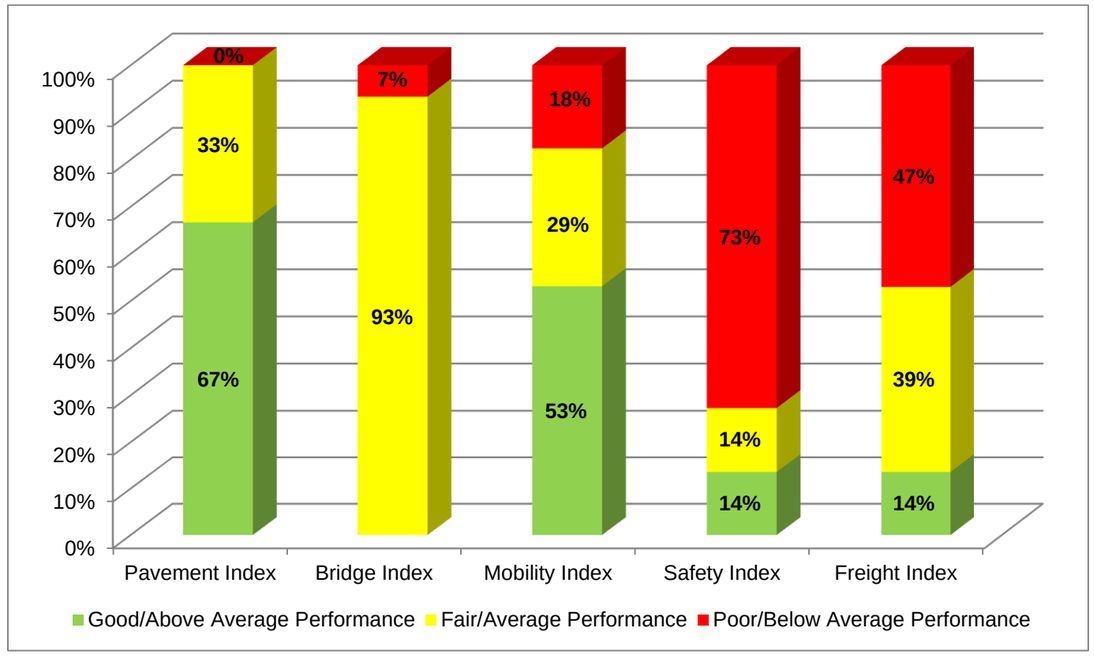


Table 3: Corridor Performance Summary by Segment and Performance Measure

Segment #	Segment Length (miles)	Pavement Performance Area				Bridge Performance Area				Mobility Performance Area											
		Pavement Index	Directional PSR		% Area Failure	Bridge Index	Sufficiency Rating	% of Deck Area on Functionally Obsolete Bridges	Lowest Bridge Rating	Mobility Index	Future Daily V/C	Existing Peak Hour V/C		Closure Extent (instances/ milepost/ year/mile)		Directional TTI (all vehicles)		Directional PTI (all vehicles)		% Bicycle Accommodation	% Non-Single Occupancy Vehicle (SOV) Trips
			NB/EB	SB/WB								NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB		
95N-1*[b2]	7	3.55	3.33		15.4%	4.00	80.90	0.0%	4	0.65	0.86	0.44	0.45	0.37	0.00	1.04	1.01	1.89	1.54	22%	15.9%
95N-2*[b1]	8	3.22	3.03		37.5%	No Bridges				0.89	1.09	0.67	0.68	0.13	1.38	1.22	1.19	3.43	3.22	1%	18.8%
95N-3*[b1]	9	3.45	3.23		22.2%	5.00	49.80	100.0%	5	1.01	1.22	0.68	0.66	0.64	0.07	1.46	1.44	8.27	5.63	0%	21.3%
68-4*[a2]	7	3.95	3.78	3.75	0.0%	6.00	87.50	0.0%	6	0.40	0.50	0.26	0.26	0.23	0.20	1.05	1.11	1.94	3.28	74%	18.5%
68-5^[a2]	10	3.73	3.61	3.45	0.0%	6.38	94.63	0.0%	6	0.20	0.22	0.17	0.17	0.26	0.16	1.06	1.03	1.71	1.39	100%	18.1%
68-6^[a1]	5	3.62	3.35	3.30	0.0%	6.32	99.60	0.0%	6	0.14	0.15	0.12	0.12	0.36	0.04	1.01	1.01	1.34	1.27	98%	16.1%
68-7^[b1]	5	3.83	3.51		0.0%	6.00	98.20	0.0%	6	0.18	0.19	0.15	0.11	0.52	0.36	1.00	1.00	1.29	1.21	98%	9.7%
Weighted Corridor Average		3.61	3.40	3.36	11.9%	6.05	92.48	6.67%	5.8	0.53	0.65	0.38	0.38	0.35	0.33	1.14	1.13	3.11	2.67	52%	17.5%

SCALES

Performance Level	Non-Interstate			All				Urban and Fringe Urban	All	Uninterrupted		All	
Good/Above Average Performance	> 3.50	> 3.50	< 5%	> 6.5	> 80	< 12%	> 6	< 0.71	< 0.22	< 1.15	< 1.3	> 90%	> 17%
Fair/Average Performance	2.90 - 3.50	2.90 - 3.50	5% - 20%	5.0 - 6.5	50 - 80	12% - 40%	5 - 6	0.71 - 0.89	0.22 - 0.62	1.15 - 1.33	1.3 - 1.5	60% - 90%	11% - 17%
Poor/Below Average Performance	< 2.90	< 2.90	> 20%	< 5.0	< 50	> 40%	< 5	> 0.89	> .62	> 1.33	> 1.5	< 60%	< 11%

Performance Level	Rural	Interrupted	
Good/Above Average Performance	< 0.56	< 1.3	< 3.0
Fair/Average Performance	0.56 - 0.76	> 1.3 & < 2.0	> 3.0 & < 6.0
Poor/Below Average Performance	> 0.76	> 2.0	> 6.0

^Uninterrupted Flow Facility
*Interrupted Flow Facility
[a]2 or 3 or 4 Lane Divided Highway
[b]4 or 5 Lane Undivided Highway
[1]Fringe Urban Operating Environment
[2]Rural Operating Environment

Table 3: Corridor Performance Summary by Segment and Performance Measure (continued)

Segment #	Segment Length (miles)	Safety Performance Area							Freight Performance Area							
		Safety Index	Directional Safety Index		% of Fatal + Incapacitating Injury Crashes Involving SHSP Top 5 Emphasis Areas Behaviors	% of Fatal + Incapacitating Injury Crashes Involving Trucks	% of Fatal + Incapacitating Injury Crashes Involving Motorcycles	% of Fatal + Incapacitating Injury Crashes Involving Non-Motorized Travelers	Freight Index	Directional TTTI		Directional TPTI		Closure Duration (minutes/milepost/year)		Bridge Vertical Clearance (feet)
			NB/EB	SB/WB						NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	
95N-1*[b2]	7	0.58	0.10	1.05	40%	Insufficient Data	Insufficient Data	20%	0.53	1.08	1.05	2.16	1.61	42.31	0.00	No UP
95N-2*[b1]	8	2.38	3.10	1.66	46%	Insufficient Data	7%	7%	0.24	1.30	1.27	4.31	3.93	15.85	226.25	No UP
95N-3*[b1]	9	2.22	0.73	3.72	34%	Insufficient Data	5%	11%	0.14	1.56	1.61	7.00	7.32	55.89	4.53	No UP
68-4*[a2]	7	1.11	1.25	0.97	100%	Insufficient Data	0%	33%	0.27	1.26	1.24	2.20	5.11	34.11	34.00	No UP
68-5^[a2]	10	2.78	1.82	3.75	46%	Insufficient Data	69%	Insufficient Data	0.45	1.27	1.01	2.05	2.44	44.42	35.24	No UP
68-6^[a1]	5	3.07	4.34	1.80	25%	Insufficient Data	8%	17%	0.63	1.05	1.00	1.46	1.71	128.68	3.56	No UP
68-7^[b1]	5	4.12	4.16	4.08	29%	Insufficient Data	Insufficient Data	18%	0.74	1.00	1.00	1.24	1.45	59.80	43.52	No UP
Weighted Corridor Average		2.25	2.00	2.51	47%	Insufficient Data	21%	16%	0.40	1.25	1.19	3.17	3.62	50.06	52.55	No UP

SCALES

Performance Level	2 or 3 or 4 Lane Divided Highway					Uninterrupted			All	
Good/Above Average Performance	< 0.77	< 44%	< 4%	< 16%	< 2%	> 0.77	< 1.15	< 1.3	< 44.18	> 16.5
Fair/Average Performance	0.77 - 1.23	44% - 54%	4% - 7%	16% - 26%	2% - 4%	0.67 - 0.77	1.15 - 1.33	1.3 - 1.5	44.18-124.86	16.0 - 16.5
Poor/Below Average Performance	> 1.23	> 54%	> 7%	> 26%	> 4%	< 0.67	> 1.33	> 1.5	> 124.86	< 16.0
Performance Level	**4 or 5 Lane Undivided Highway**					**Interrupted**				
Good/Above Average Performance	< 0.80	< 42%	< 6%	< 6%	< 5%	> 0.33	< 1.3	< 3.0		
Fair/Average Performance	0.80 - 1.20	42% - 51%	6% - 10%	6% - 9%	5% - 8%	0.17 - 0.33	1.3 - 2.0	3.0 - 6.0		
Poor/Below Average Performance	> 1.20	> 51%	> 10%	> 9%	> 8%	< 0.17	> 2.0	> 6.0		

^Uninterrupted Flow Facility
*Interrupted Flow Facility
[a]2 or 3 or 4 Lane Divided Highway
[b]4 or 5 Lane Undivided Highway
[1]Fringe Urban Operating Environment
[2]Rural Operating Environment

Notes: *"Insufficient Data" indicates there was not enough data available to generate reliable performance ratings*
"No UP" indicates no underpasses are present in the segment

3.0 NEEDS ASSESSMENT

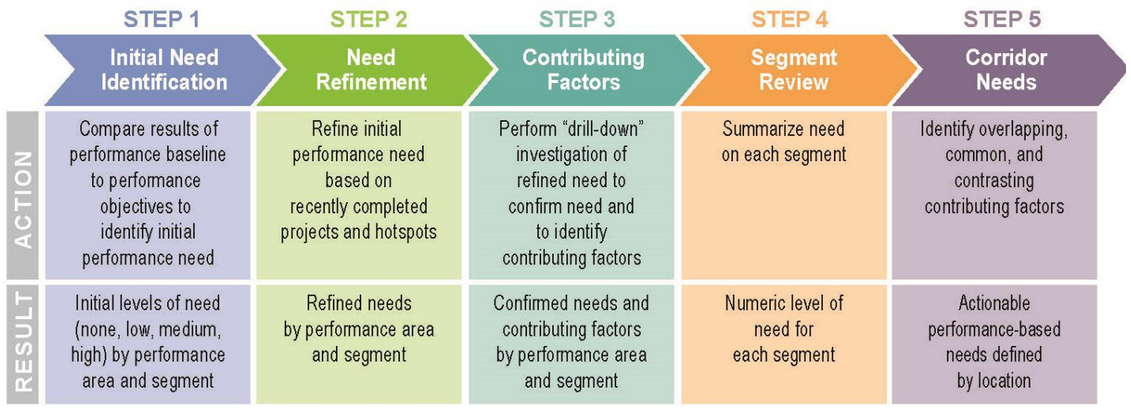
3.1 Needs Assessment Process

The following guiding principles were used as an initial step in developing a framework for the performance-based needs assessment process:

- Corridor needs are defined as the difference between the corridor performance and the performance objectives
- The needs assessment process should be systematic, progressive, and repeatable, but also allow for engineering judgment where needed
- The process should consider all primary and secondary performance measures developed for the study
- The process should develop multiple need levels including programmatic needs for the entire length of the corridor, performance area-specific needs, segment-specific needs, and location-specific needs (defined by MP limits)
- The process should produce actionable needs that can be addressed through strategic investments in corridor preservation, modernization, and expansion

The performance-based needs assessment process is illustrated in **Figure 5**.

Figure 5: Needs Assessment Process



The needs assessment compares baseline corridor performance with performance objectives to provide a starting point for the identification of performance needs. This mathematical comparison results in an initial need rating of None, Low, Medium, or High for each primary and secondary performance measure. An illustrative example of this process is shown below in **Figure 6**.

Figure 6: Initial Need Ratings in Relation to Baseline Performance (Bridge Example)

Performance Thresholds	Performance Level	Initial Level of Need	Description
6.5	Good	None*	All levels of Good and top 1/3 of Fair (>6.0)
	Good		
	Good		
	Fair		
5.0	Fair	Low	Middle 1/3 of Fair (5.5-6.0)
	Fair	Medium	Lower 1/3 of Fair and top 1/3 of Poor (4.5-5.5)
	Poor		
	Poor	High	Lower 2/3 of Poor (<4.5)
	Poor		

**A segment need rating of 'None' does not indicate a lack of needed improvements; rather, it indicates that the segment performance score exceeds the established performance thresholds and strategic solutions for that segment will not be developed as part of this study.*

The initial level of need for each segment is refined to account for hot spots and recently completed or under construction projects, resulting in a final level of need for each segment. The final levels of need for each primary and secondary performance measure are combined to produce a weighted final need rating for each segment. A detailed review of available data helps identify contributing factors to the need and if there is a high level of historical investment.

3.2 Summary of Corridor Needs

The needs in each performance area are shown in **Table 4** and **Figure 7** and summarized below:

Pavement Needs

- Three segments (95N-1, 95N-2, and 95N-3) contain Pavement hot spots
- Segment 95N-2 has a final segment need of Medium while Segments 95N-1, 95N-3, and 68-6 have a final segment need of Low; all other segments on the corridor have a final segment need of None
- No segments were identified as having potential pavement repetitive historical investment issues

Bridge Needs

- One segment (95N-1) has a Bridge hot spot but it does not have potential repetitive historical investment issues
- One bridge in Segment 95N-3 has potential repetitive historical investment issues, an evaluation rating of 5, and is considered functionally obsolete, but it is not a bridge hot spot
- Segments 95N-1 and 95N-3 have a final segment need of High; all other segments on the corridor have a final segment need of None

Mobility Needs

- Segments 95N-2 and 95N-3 have a final segment need of High; Segment 95N-1 has a final segment need of Medium; all other segments on the corridor have a final segment need of Low
- Mobility needs are primarily related to high existing and projected traffic volumes, high PTI, and lack of bicycle accommodation

Safety Needs

- All segments have a final segment need of High except Segment 95N-1, which has a final segment need of Low
- Safety hot spots exist in all segments except Segment 68-4
- Contributing factors to the Safety needs include lack of access control, numerous driveways, high traffic volumes, and speeding
- Crashes involving non-motorized travelers (i.e., pedestrians and bicyclists) are above the statewide average for five of the seven corridor segments

Freight Needs

- No Freight hot spots exist along the corridor
- Segments 95N-3, 68-5, and 68-6 have a final segment need of High while Segments 95N-2, 68-4, and 68-7 have a final segment need of Low; all other segments on the corridor have a final segment need of None
- Freight needs are primarily related to high PTI

Overlapping Needs

This section identifies overlapping performance needs on the SR 68/SR 95 North corridor, which provides guidance to develop strategic solutions that address more than one performance area with elevated levels of need (i.e., Medium or High). Completing projects that address multiple needs presents the opportunity to more effectively improve overall performance. A summary of the overlapping needs that relate to locations with elevated levels of need is provided below:

- Segment 95N-1 contains elevated needs in the Bridge and Mobility performance areas
- Segment 95N-2 contains elevated needs in the Pavement, Mobility, and Safety performance areas
- Segment 95N-3, which has the highest average need score of all the segments of the corridor, has elevated needs in Bridge, Mobility, Safety, and Freight
- Segments 68-5 and 68-6 contain elevated needs in the Safety and Freight performance areas

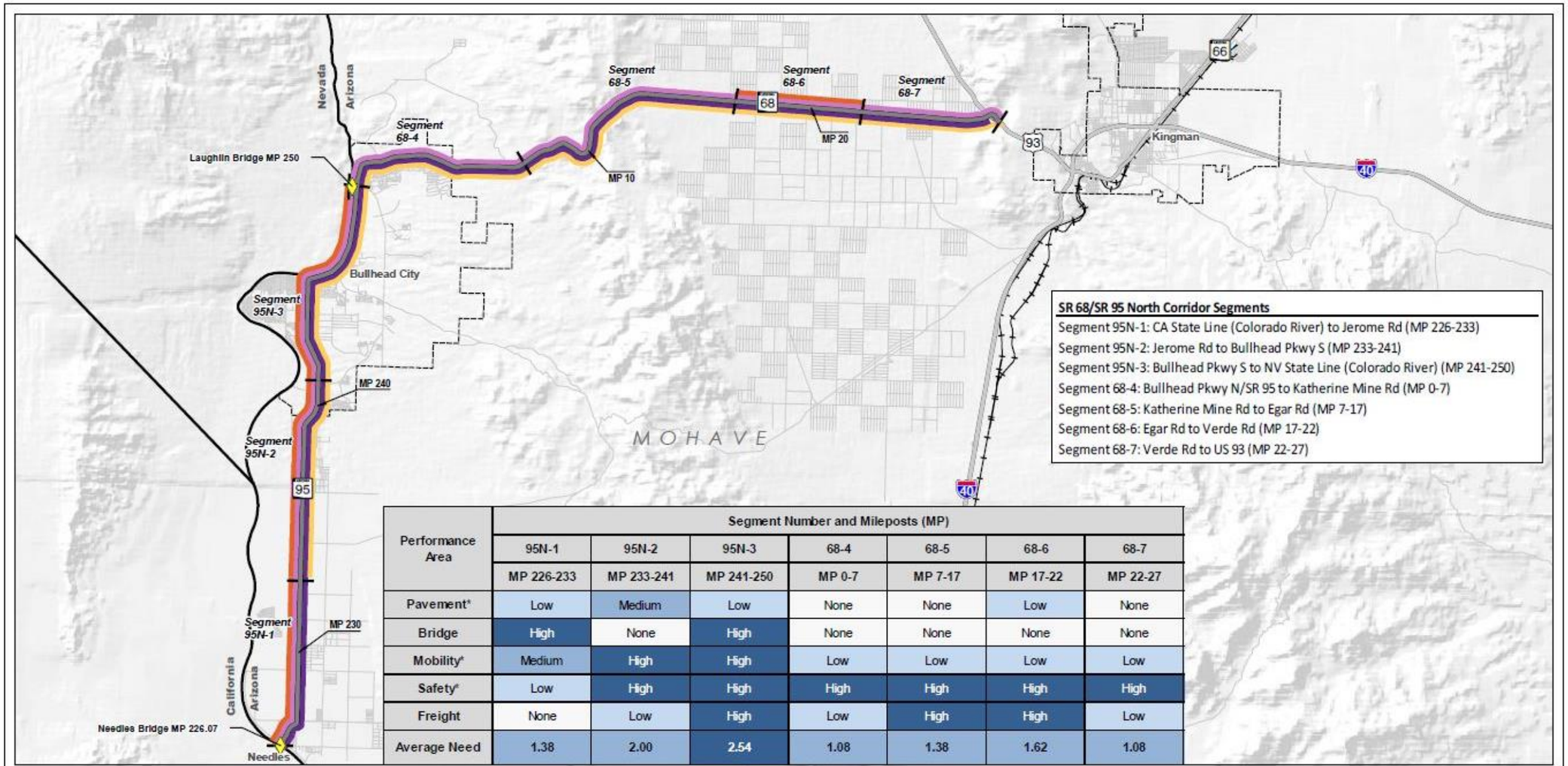
Table 4: Summary of Needs by Segment

Performance Area	Segment Number and Mileposts (MP)						
	95N-1	95N-2	95N-3	68-4	68-5	68-6	68-7
	MP 226-233	MP 233-241	MP 241-250	MP 0-7	MP 7-17	MP 17-22	MP 22-27
Pavement*	Low	Medium	Low	None	None	Low	None
Bridge	High	None	High	None	None	None	None
Mobility*	Medium	High	High	Low	Low	Low	Low
Safety*	Low	High	High	High	High	High	High
Freight	None	Low	High	Low	High	High	Low
Average Need	**1.38**	**2.00**	**2.54**	**1.08**	**1.38**	**1.62**	**1.08**

* Identified as Emphasis Areas for SR 68/SR 95 North Corridor
[#] N/A indicates insufficient or no data available to determine level of need
[+] A segment need rating of 'None' does not indicate a lack of needed improvements; rather, it indicates that the segment performance score exceeds the established performance thresholds and strategic solutions for that segment will not be developed as part of this study

Level of Need	Average Need Range
None[+]	< 0.1
Low	0.1 - 1.0
Medium	1.0 - 2.0
High	> 2.0

Figure 7: Corridor Needs Summary



Performance Area	Segment Number and Mileposts (MP)						
	95N-1	95N-2	95N-3	68-4	68-5	68-6	68-7
	MP 226-233	MP 233-241	MP 241-250	MP 0-7	MP 7-17	MP 17-22	MP 22-27
Pavement*	Low	Medium	Low	None	None	Low	None
Bridge	High	None	High	None	None	None	None
Mobility*	Medium	High	High	Low	Low	Low	Low
Safety*	Low	High	High	High	High	High	High
Freight	None	Low	High	Low	High	High	Low
Average Need	1.38	2.00	2.54	1.08	1.38	1.62	1.08

* Identified as Emphasis Areas for SR 68/SR 95 North Corridor
# N/A indicates insufficient or no data available to determine level of need
* A segment need rating of 'None' does not indicate a lack of needed improvements; rather, it indicates that the segment performance score exceeds the established performance thresholds and strategic solutions for that segment will not be developed as part of this study

Level of Need	Average Need
None+	< 0.1
Low	0.1 - 1.0
Medium	1.0 - 2.0
High	> 2.0

SR 68/SR 95 North Corridor Profile Study: US 93 to CA State Line
Needs Summary

4.0 STRATEGIC SOLUTIONS

The principal objective of the CPS is to identify strategic solutions (investments) that are performance-based to ensure that available funding resources are used to maximize the performance of the State's key transportation corridors. One of the first steps in the development of strategic solutions is to identify areas of elevated levels of need (i.e., Medium or High). Addressing areas of Medium or High need will have the greatest effect on corridor performance and are the focus of the strategic solutions. Segments with Medium or High needs and specific locations of hot spots are considered strategic investment areas for which strategic solutions should be developed. Segments with lower levels of need or without identified hot spots are not considered candidates for strategic investment and are expected to be addressed through other ADOT programming processes. The SR 68/SR 95 North strategic investment areas (resulting from the elevated needs) are shown in **Figure 8**.

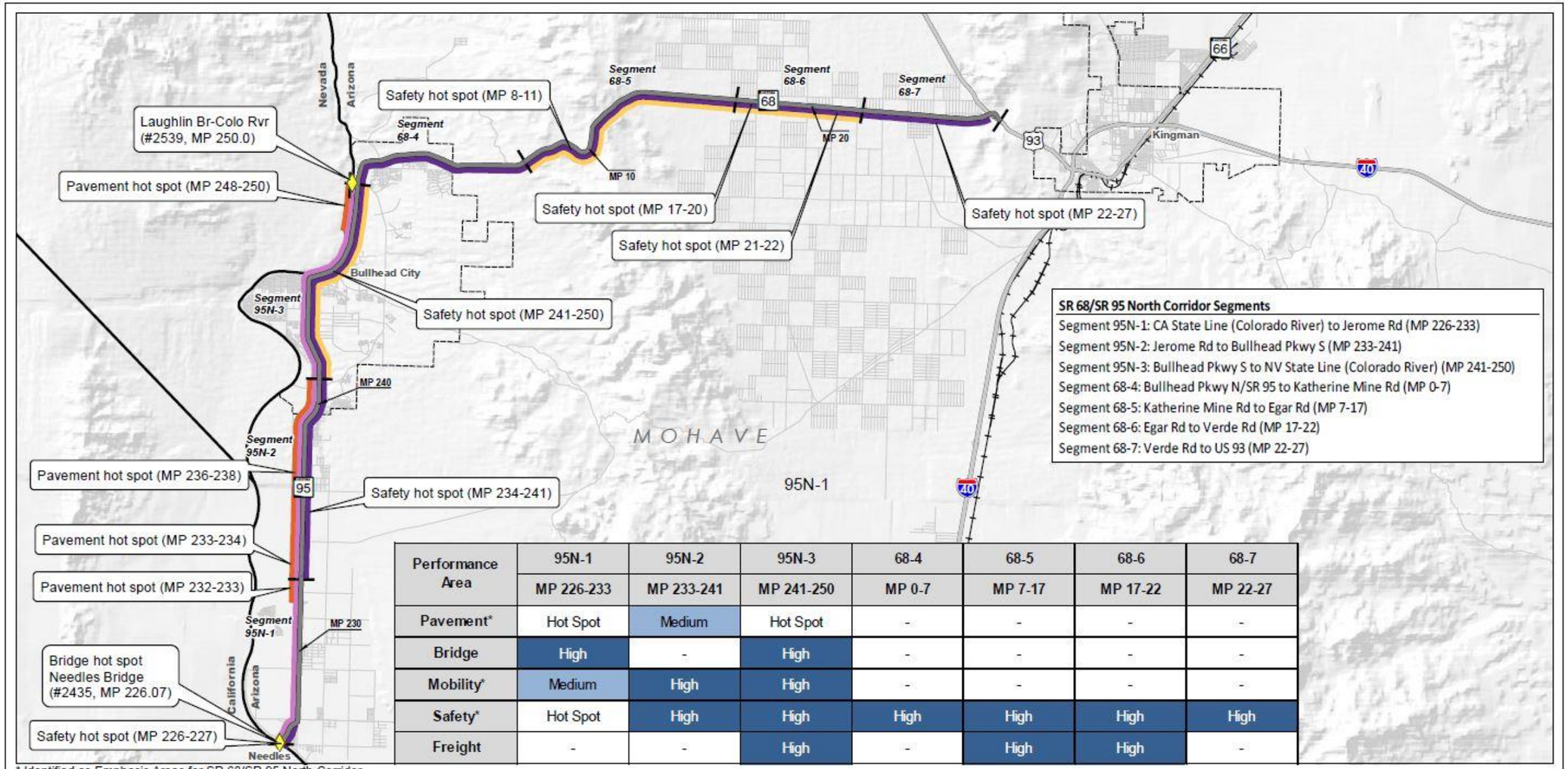
4.1 Screening Process

This section examines qualifying strategic needs and determines if the needs in those locations require action. In some cases, needs that are identified do not advance to solutions development and are screened out from further consideration because they have been or will be addressed through other measures, including:

- A project is programmed to address this need
- The need is a result of a Pavement or Bridge hot spot that does not show historical investment or rating issues; these hot spots will likely be addressed through other ADOT programming means
- A bridge is not a hot spot but is located within a segment with a Medium or High level of need; this bridge will likely be addressed through current ADOT bridge maintenance and preservation programming processes
- The need is determined to be non-actionable (i.e., cannot be addressed through an ADOT project)
- The conditions/characteristics of the location have changed since the performance data was collected that was used to identify the need

Table 5 notes if each potential strategic need advanced to solution development, and if not, the reason for screening the potential strategic need out of the process. Locations advancing to solutions development are marked with Yes (Y); locations not advancing are marked with No (N) and highlighted. This screening table provides specific information about the needs in each segment that will be considered for strategic investment. The table identifies the level of need – either Medium or High segment needs, or segments without Medium or High level of need that have a hot spot. Each area of need is assigned a location number in the screening table to help document and track locations considered for strategic investment.

Figure 8: Strategic Investment Areas



Performance Area	95N-1	95N-2	95N-3	68-4	68-5	68-6	68-7
	MP 226-233	MP 233-241	MP 241-250	MP 0-7	MP 7-17	MP 17-22	MP 22-27
Pavement*	Hot Spot	Medium	Hot Spot	-	-	-	-
Bridge	High	-	High	-	-	-	-
Mobility*	Medium	High	High	-	-	-	-
Safety*	Hot Spot	High	High	High	High	High	High
Freight	-	-	High	-	High	High	-

* Identified as Emphasis Areas for SR 68/SR 95 North Corridor
\# N/A indicates insufficient or no data available to determine level of need

Note: Figure shows strategic investment areas, which are segments with Medium and High levels of need and locations of hot spots. A "-" symbol indicates a segment level of need of Low or None, which is not considered strategic

SR 68/SR 95 North Corridor Profile Study: US 93 to CA State Line
Strategic Investment Areas

Table 5: Strategic Investment Area Screening

Segment # and MP	Level of Strategic Need: Pavement	Bridge	Mobility	Safety	Freight	Location #	Type	Need Description	Advance (Y/N)	Screening Description
95N-1 (MP 226-233)	Hot Spot	High	Medium	Hot Spot		L1	Pavement	Hot spot at MP 232-233	N	No high historical investment so not considered a strategic investment; will likely be addressed by current ADOT processes
						L2	Bridge	Needles Bridge #2435 at MP 226.07 has deck rating of 4 and is considered structurally deficient; not identified in historical review; considered a hot spot; City of Needles responsibility with ADOT as financial partner	N	No high historical investment so not considered a strategic investment; City of Needles has developed scoping letter for repaving of Needles Bridge
						L3	Mobility	MP 226-233 has a Medium level of need based on the Future Daily V/C and Bicycle Accommodation ratings	Y	No programmed project to address Mobility need
						L4	Safety	Hot spot MP 226-227	Y	No programmed project to address Safety hot spot
95N-2 (MP 233-241)	Medium		High	High		L5	Pavement	MP 233-241 has a Medium level of need due to fair performance scores for Pavement Index and Directional PSR measures; segment also has poor % Area Failure ratings Hot spots at MP 233-234 and MP 236-238	N	No high historical investment so not considered a strategic investment; will likely be addressed by current ADOT processes
						L6	Mobility	MP 233-241 has a High level of need based on the Future Daily V/C, SB/WB Closure Extent, and Bicycle Accommodation ratings	Y	No programmed project to address Mobility need
						L7	Safety	MP 233-241 has a Safety Index and Directional Safety Indices above statewide averages Hot spot MP 234-241 7 fatal crashes, 50 incapacitating crashes, 4 crashes involving trucks, 4 crashes involving pedestrians/bikes, and 4 crashes involving motorcycles; crash data analysis indicates 32% involve left turn, 25% involve rear end, and 30% involved failure to yield right-of-way	Y	Programmed SR 95 Teller Road-Aztec Road, construct raised median and roundabout (FY 2019) Programmed SR 95 Aztec Road-Valencia Road and Camp Mohave Roundabout, construct raised median (FY 2020) and roundabout (FY 2019) Programmed projects do not address full extent of Safety needs

Legend: Strategic investment area screened out from further consideration

Table 5: Strategic Investment Area Screening (continued)

Segment # and MP	Level of Strategic Need					Location #	Type	Need Description	Advance (Y/N)	Screening Description
	Pavement	Bridge	Mobility	Safety	Freight					
95N-3 (MP 241-250)	Hot Spot	High	High	High	High	L8	Pavement	Hot spot at MP 248-250	N	No high historical investment so not considered a strategic investment; will likely be addressed by current ADOT processes
						L9	Bridge	Laughlin Br-Colo Rvr #2539 at MP 250.0 has evaluation rating of 5, sufficiency rating of 49.80, and is considered functionally obsolete; identified in historical review due to decrease in sufficiency rating of greater than 20 points; is not considered a hot spot; Nevada DOT responsibility with ADOT as financial partner	N	Bridge does not have a rating of 4 or multiple ratings of 5 so it is not a hot spot and therefore is not considered a strategic investment; Nevada DOT has project programmed in 2021 to widen Laughlin Bridge to add sidewalk and shoulders but not additional lanes
						L10	Mobility	MP 241-250 has a High level of need based on Future Daily V/C, NB/EB Closure Extent, NB/EB Directional PTI, and Bicycle Accommodation ratings	Y	No programmed project to address Mobility need
						L11	Safety	MP 241-250 has an overall Safety Index and SB/WB Directional Safety Index above statewide averages Hot spot MP 241-250 10 fatal crashes, 28 incapacitating crashes, 2 crashes involving trucks, 4 crashes involving pedestrians/bikes, and 2 crashes involving motorcycles; crash data analysis indicates percentage of crashes above statewide average related to collisions with non-motorized travelers; 32% involve left turn, 24% involved failure to yield right-of-way, 24% involve disregarded traffic signal, and 18% under the influence of drugs or alcohol	Y	No programmed project to address Safety need
						L12	Freight	MP 241-250 has a High level of need based on the overall Freight Index and Directional TPTI ratings	Y	No programmed project to address Freight need
68-4 (MP 0-7)				High		L13	Safety	MP 0-7 has a NB/EB Directional Safety Index above statewide average 2 fatal crashes, 4 incapacitating crashes, and 2 crashes involving pedestrians/bikes; crash data analysis indicates percentage of crashes above statewide average related to collisions involving SHSP top 5 emphasis areas behaviors and with non-motorized travelers; 33% involve collision with pedestrian, 17% involved rear end and head on, 67% occurred in dark-unlighted conditions, and 33% under the influence of drugs or alcohol	Y	No programmed project to address Safety need

Legend: Strategic investment area screened out from further consideration

Table 5: Strategic Investment Area Screening (continued)

Segment # and MP	Level of Strategic Need					Location #	Type	Need Description	Advance (Y/N)	Screening Description
	Pavement	Bridge	Mobility	Safety	Freight					
68-5 (MP 7-17)				High	High	L14	Safety	MP 7-17 has an overall Safety Index and Directional Safety Indices above the statewide average Hot spot MP 8-11 7 fatal crashes, 6 incapacitating crashes, and 9 crashes involving motorcycles; crash data analysis indicates percentage of crashes above statewide average related to collisions with motorcycles; 46% involve overturning, 31% involve collision with fixed object, 85% involve single vehicle, 46% ran off the road, and 23% under the influence of drugs or alcohol	Y	No programmed project to address Safety need
						L15	Freight	MP 7-17 has a High level of need based on the overall Freight Index and Directional TPTI ratings	Y	No programmed project to address Freight need
68-6 (MP 17-22)				High	High	L16	Safety	MP 17-22 has an overall Safety Index and Directional Safety Indices above the statewide average Hot spots MP 17-20 and MP 21-22 4 fatal crashes, 8 incapacitating crashes, 2 crashes involving trucks, 2 crashes involving pedestrians/bikes, and 1 crash involving motorcycles; crash data analysis indicates percentage of crashes above statewide average related to collisions with non-motorized travelers; 17% involve collision with pedestrian, 17% involve left turn, and 33% involved failure to yield right-of-way	Y	No programmed project to address Safety need
						L17	Freight	MP 17-22 has a High level of need based on the overall Freight Index, SB/WB Directional TPTI, and NB/EB Closure Duration	Y	No programmed project to address Freight need

Legend: Strategic investment area screened out from further consideration

Table 5: Strategic Investment Area Screening (continued)

Segment # and MP	Level of Strategic Need					Location #	Type	Need Description	Advance (Y/N)	Screening Description
	Pavement	Bridge	Mobility	Safety	Freight					
68-7 (MP 22-27)				High		L18	Safety	MP 22-27 has an overall Safety Index and Directional Safety Indices above the statewide average Hot spot MP 22-27 8 fatal crashes, 9 incapacitating crashes, 1 crash involving trucks, 3 crashes involving pedestrians/bikes, and 2 crashes involving motorcycles; crash data analysis indicates percentage of crashes above statewide average related to collisions with non-motorized travelers; 18% involve collision with pedestrian, 29% involve left turn, 41% involved failure to yield right-of-way, 24% involve drove in opposing lane, 29% occur in dark-unlighted conditions, and 18% under the influence of drugs or alcohol	Y	No programmed project to address Safety need

Legend: Strategic investment area screened out from further consideration

4.2 Candidate Solutions

For each elevated need within a strategic investment area that is not screened out, a candidate solution is developed to address the identified need. Each candidate solution is assigned to one of the following three P2P investment categories based on the scope of the solution:

- Preservation
- Modernization
- Expansion

Documented performance needs serve as the foundation for developing candidate solutions for corridor preservation, modernization, and expansion. Candidate solutions are not intended to be a substitute or replacement for traditional ADOT project development processes where various ADOT technical groups and districts develop candidate projects for consideration in the performance-based programming in the P2P process. Rather, these candidate solutions are intended to complement ADOT's traditional project development processes through a performance-based process to address needs in one or more of the five performance areas of Pavement, Bridge, Mobility, Safety, and Freight. Candidate solutions developed for the SR 68/SR 95 North corridor will be considered along with other candidate projects in the ADOT statewide programming process.

Characteristics of Strategic Solutions

Candidate solutions should include some or all of the following characteristics:

- Do not recreate or replace results from normal programming processes
- May include programs or initiatives, areas for further study, and infrastructure projects
- Address elevated levels of need (High or Medium) and hot spots
- Focus on investments in modernization projects (to optimize current infrastructure)
- Address overlapping needs
- Reduce costly repetitive maintenance
- Extend operational life of system and delay expansion
- Leverage programmed projects that can be expanded to address other strategic elements
- Provide measurable benefit

Candidate Solutions

A set of 7 candidate solutions are proposed to address the identified needs on the SR 68/SR 95 North corridor.

Table 6 identifies each strategic location that has been assigned a candidate solution with a number (e.g., 95N.1, CS68.2, etc.). Each candidate solution is comprised of one or more components to address the identified needs. The assigned candidate solution numbers are linked to the location number and provide tracking capability through the rest of the process. The locations of proposed solutions are shown on the map in **Figure 9**.

Candidate solutions developed to address an elevated need in the Pavement or Bridge performance area will include two options: rehabilitation or full replacement. These solutions are initially evaluated through a Life-Cycle Cost Analysis (LCCA) to provide insights into the cost-effectiveness of these options so a recommended approach can be identified. Candidate solutions developed to address an elevated need in the Mobility, Safety, or Freight performance areas are advanced directly to the Performance Effectiveness Evaluation. In some cases, there may be multiple solutions identified to address the same area of need.

Candidate solutions that are recommended to expand or modify the scope of an already programmed project are noted and are not advanced to solution evaluation and prioritization. These solutions are directly recommended for programming.

Table 6: Candidate Solutions

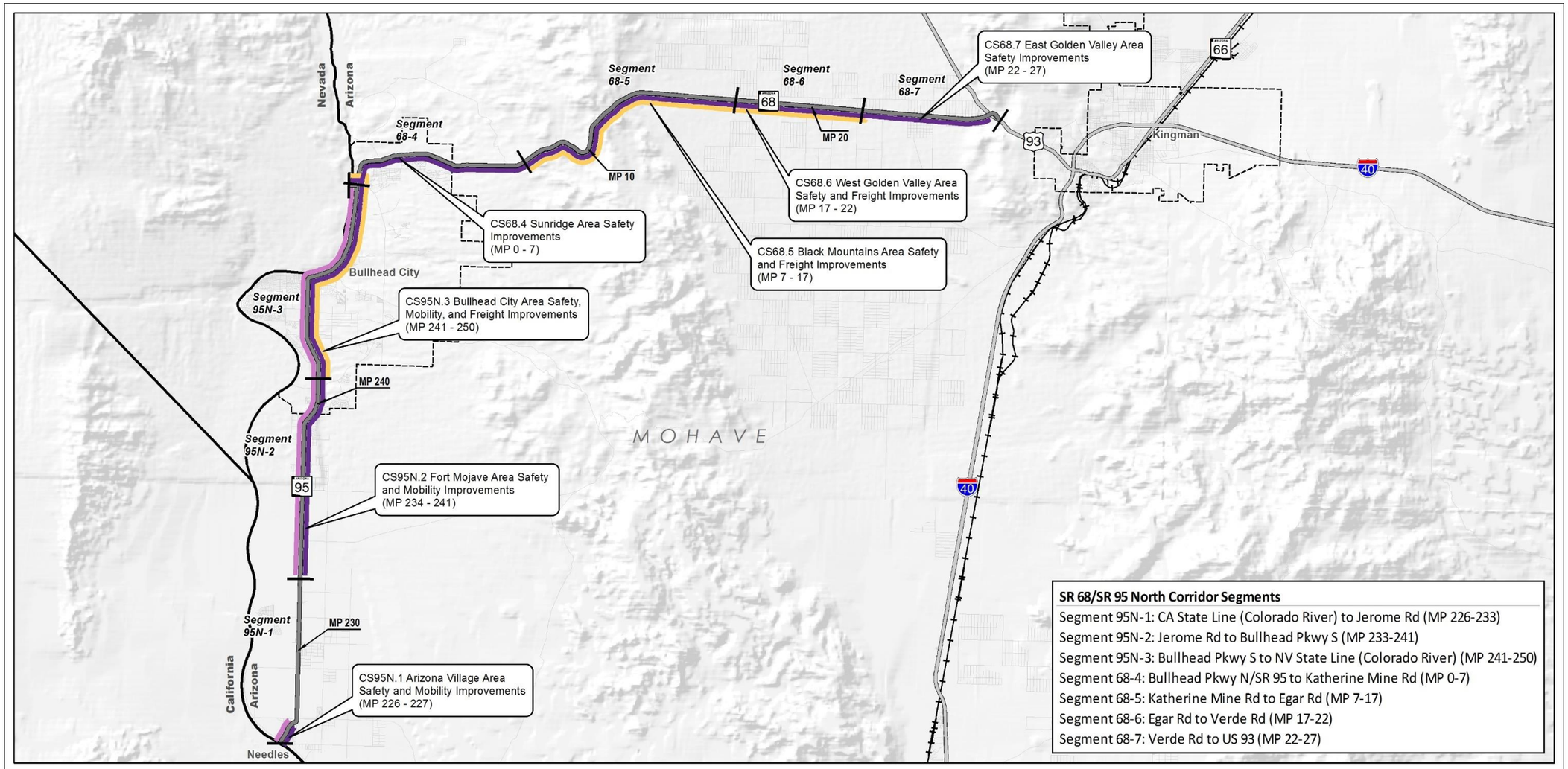
Candidate Solution #	Segment #	Location #	Beginning Milepost	Ending Milepost	Candidate Solution Name	Option*	Scope	Investment Category (Preservation [P], Modernization [M], Expansion [E])
CS95N.1	95N-1	L3/L4	226	227	Arizona Village Area Safety and Mobility Improvements	A	-Convert to a 4-lane highway with raised median, Colorado River Bridge (MP 226.1) to Courtwright Road (MP 227.3)	E
						B	-Construct raised median, Colorado River Bridge (MP 226.1) to Courtwright Road (MP 227.3)	M
CS95N.2	95N-2	L6/L7	234	241	Fort Mohave Area Safety and Mobility Improvements	-	-Implement signal coordination from Boundary Cone Road (MP 234.4) to Bullhead Parkway South (MP 240.7), a total of 9 signals -Improve signal visibility at Boundary Cone Road (MP 234.4) and El Rodeo Drive (MP 237.4) intersections -Construct raised median, sidewalks, curb, and gutter, where not existing, from south of Lipan Blvd (MP 235.0) to Teller Lane (MP 237.1) -Provide continuous lighting on both sides of the roadway from south of Lipan Blvd (MP 235.0) through El Rodeo Drive (MP 237.4) and Valencia Road (MP 238.9) to Sterling Road (MP 239.5) -Construct traffic signal at Chaparral Road (MP 236.2) -Construct raised median, sidewalks, curb, and gutter, where not existing, from Valencia Road (MP 238.9) to north of Bullhead Parkway South (MP 241.0) -Construct traffic signal at Corwin Road (MP 239.9)	M
CS95N.3	95N-3	L10/L11/ L12	241	250	Bullhead City Area Safety, Mobility, and Freight Improvements	-	-Construct raised median from north of Bullhead Parkway South (MP 241.0) to Aviation Way (MP 249.5) -Implement signal coordination from Mohave Community College access (MP 241.1) to Bullhead Parkway North (MP 249.8), a total of 18 signals -Improve signal visibility at Mohave Drive (MP 242.8) and Ramar Road (MP 244.9) -Construct SB right-turn lanes at Marina Blvd (MP 243.9) and Thunderstruck Drive (244.2) -Implement protected left-turn phasing at Hancock Road (MP 244.3) -Install sidewalk on the west side of SR 95, MP 241.0-241.7 and 242.2-242.8	M
CS68.4	68-4	L13	0	7	Sunridge Area Safety Improvements	-	-Improve delineation in both directions (striping, delineators, and RPMs), MP 0.0-1.3 -Install curve warning signs and chevrons (both directions), MPs 0.6-0.9, 4.1-4.6, and 6.5-6.9 -Rehabilitate shoulders in both directions (striping, delineators, RPMs, safety edge, and rumble strips for both shoulders), MP 1.3-7.0 -Construct raised median, MP 2.1-2.6 -Install lighting (both directions), MP 2.1-3.0	M

Table 6: Candidate Solutions (continued)

Candidate Solution #	Segment #	Location #	Beginning Milepost	Ending Milepost	Candidate Solution Name	Option*	Scope	Investment Category (Preservation [P], Modernization [M], Expansion [E])
CS68.5	68-5	L14/L15	7	17	Black Mountains Area Safety and Freight Improvements	A	-Install cable median barrier, MP 8.6-11.1 -Rehabilitate shoulders in both directions (striping, delineators, RPMs, safety edge, and rumble strips for both shoulders), MP 7.0-17.0 -Install speed feedback signs, EB MP 8.6 and WB MP 11.1 -Install curve warning signs with flashing beacons and chevrons (both directions), MPs 8.6-9.1 and 10.6-11.1	M
						B	-Install raised concrete barrier in median, MP 8.6-11.1 -Rehabilitate shoulders in both directions (striping, delineators, RPMs, safety edge, and rumble strips for both shoulders), MP 7.0-17.0 -Install speed feedback signs, EB MP 8.6 and WB MP 11.1 -Install curve warning signs with flashing beacons and chevrons (both directions), MPs 8.6-9.1 and 10.6-11.1	M
CS68.6	68-6	L16/L17	17	22	West Golden Valley Area Safety and Freight Improvements	-	-Construct indirect left-turn improvements at Egar Road (MP 16.8) and Estrella Road (MP 17.8) with a raised median in between -Construct left-in only raised median improvements at Milky Way Road (MP 18.7) -Construct indirect left-turn improvement with a raised median at Teddy Roosevelt Road (MP 19.8) -Construct double-lane roundabouts at Colorado Road (MP 20.8) and Verde Road (MP 21.8) with a raised median, MP 20.8-22.0 -Provide lighting at major intersections (6 total including Egar, Estrella, Milky Way, Teddy Roosevelt, Colorado, and Verde), MP 16.8-22.0	M
CS68.7	68-7	L18	22	27	East Golden Valley Area Safety Improvements	-	-Construct raised median, MP 22.0-26.8 -Construct double-lane roundabouts at the following locations: Adobe Road (MP 22.8), Aztec Road (MP 23.8), and Bacobi Road (MP 24.8) -Provide lighting at Adobe Road intersection, and from MP 23.7-24.9 and MP 25.3-26.7	M

* '-': Indicates only one solution is being proposed and no options are being considered

Figure 9: Candidate Solutions



SR 68/SR 95 North Corridor Profile Study: US 93 to CA State Line
Candidate Solutions

5.0 SOLUTION EVALUATION AND PRIORITIZATION

Candidate solutions are evaluated using the following steps: LCCA (where applicable), Performance Effectiveness Evaluation, Solution Risk Analysis, and Candidate Solution Prioritization. The methodology and approach to this evaluation are shown in **Figure 10** and described more fully below.

Life-Cycle Cost Analysis

All Pavement and Bridge candidate solutions have two options: rehabilitation/repair or reconstruction. These options are evaluated through an LCCA to determine the best approach for each location where a Pavement or Bridge solution is recommended. The LCCA can eliminate options from further consideration and identify which options should be carried forward for further evaluation.

When multiple independent candidate solutions are developed for Mobility, Safety, or Freight strategic investment areas, these candidate solution options advance directly to the Performance Effectiveness Evaluation without an LCCA.

Performance Effectiveness Evaluation

After completing the LCCA process, all remaining candidate solutions are evaluated based on their performance effectiveness. This process includes determining a Performance Effectiveness Score (PES) based on how much each solution impacts the existing performance and needs scores for each segment. This evaluation also includes a Performance Area Risk Analysis to help differentiate between similar solutions based on factors that are not directly addressed in the performance system.

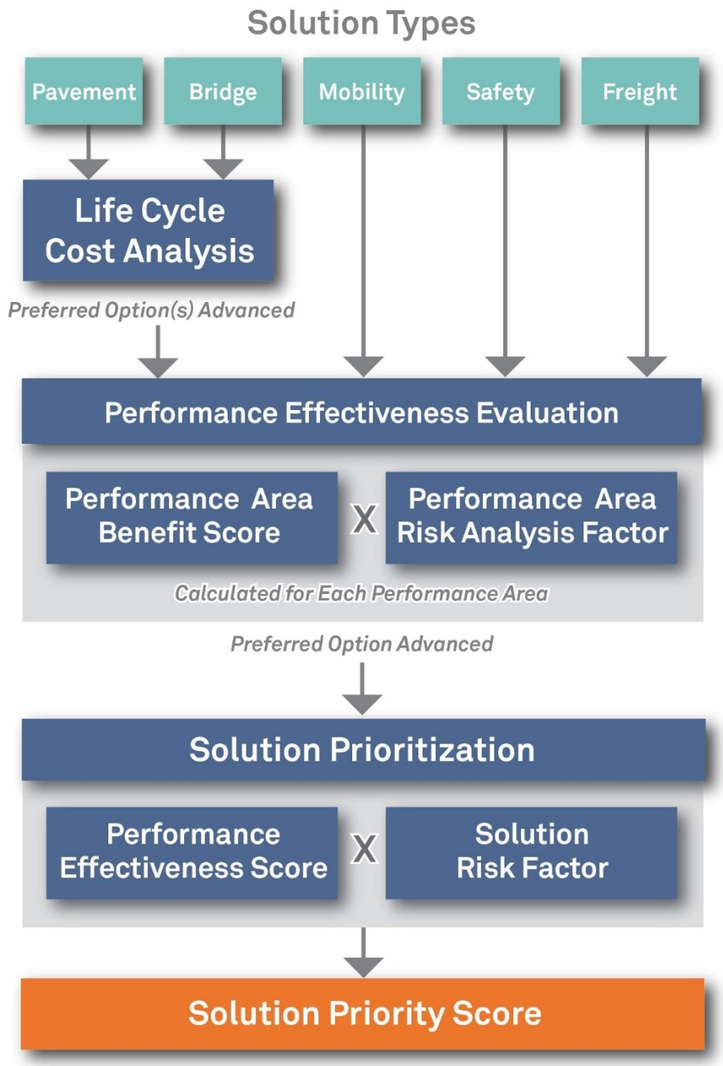
Solution Risk Analysis

All candidate solutions advanced through the Performance Effectiveness Evaluation are also evaluated through a Solution Risk Analysis process. A solution risk probability and consequence analysis is conducted to develop a solution-level risk weighting factor. This risk analysis is a numeric scoring system to help address the risk of not implementing a solution based on the likelihood and severity of performance failure.

Candidate Solution Prioritization

The PES, weighted risk factor, and segment average need score are combined to create a prioritization score. The candidate solutions are ranked by prioritization score from highest to lowest. The highest prioritization score indicates the candidate solution that is recommended as the highest priority. Solutions that address multiple performance areas tend to score higher in this process.

Figure 10: Candidate Solution Evaluation Process



5.1 Life-Cycle Cost Analysis

LCCA is conducted for any candidate solution that is developed as a result of a need in the Pavement or Bridge performance area. The intent of the LCCA is to determine which options warrant further investigation and eliminate options that would not be considered strategic.

LCCA is an economic analysis that compares cost streams over time and presents the results in a common measure, the present value of all future costs. The cost stream occurs over an analysis period that is long enough to provide a reasonably fair comparison among alternatives that may differ significantly in scale of improvement actions over shorter time periods. For both bridge and pavement LCCA, the costs are focused on agency (ADOT) costs for corrective actions to meet the objective of keeping the bridge or pavement serviceable over a long period of time.

LCCA is performed to provide a more complete holistic perspective on asset performance and agency costs over the life of an investment stream. This approach helps ADOT look beyond initial and short-term costs, which often dominate the considerations in transportation investment decision making and programming.

Bridge LCCA

For the bridge LCCA, three basic strategies are analyzed that differ in timing and scale of improvement actions to maintain the selected bridges, as described below:

- Bridge replacement (large upfront cost but small ongoing costs afterwards)
- Bridge rehabilitation until replacement (moderate upfront costs then small to moderate ongoing costs until replacement)
- On-going repairs until replacement (low upfront and ongoing costs until replacement)

The bridge LCCA model developed for the CPS reviews the characteristics of the candidate bridges including bridge ratings and deterioration rates to develop the three improvement strategies (full replacement, rehabilitation until replacement, and repair until replacement). Each strategy consists of a set of corrective actions that contribute to keeping the bridge serviceable over the analysis period. Cost and effect of these improvement actions on the bridge condition are essential parts of the model. Other considerations in the model include bridge age, elevation, pier height, length-to-span ratio, skew angle, and substandard characteristics such as shoulders and vehicle clearance. The following assumptions are included in the bridge LCCA model:

- The bridge LCCA only addresses the structural condition of the bridge and does not address other issues or costs
- The bridge will require replacement at the end of its 75-year service life regardless of current condition
- The bridge elevation, pier height, skew angle, and length-to-span ratio can affect the replacement and rehabilitation costs
- The current and historical ratings are used to estimate a rate of deterioration for each candidate bridge
- Following bridge replacement, repairs will be needed every 20 years
- Different bridge repair and rehabilitation strategies have different costs, expected service life, and benefit to the bridge rating
- The net present value of future costs is discounted at 3% and all dollar amounts are in 2015 dollars
- If the LCCA evaluation recommends rehabilitation or repair, the solution is not considered strategic and the rehabilitation or repair will be addressed by normal programming processes
- Because this LCCA is conducted at a planning level, and due to the variabilities in costs and improvement strategies, the LCCA net present value results that are within 15% should be considered equally; in such a case, the solution should be carried forward as a strategic replacement project – more detailed scoping will confirm if replacement or rehabilitation is needed

Based on the candidate solutions presented in **Table 6**, LCCA was not conducted for any bridges on the SR 68/SR 95 North corridor, as noted in **Table 7**. Additional information regarding the bridge LCCA is included in **Appendix E**.

Pavement LCCA

The LCCA approach to pavement is very similar to the process used for bridges. For the pavement LCCA, three basic strategies are analyzed that differ in timing and scale of improvement actions to maintain the selected pavement, as described below:

- Pavement replacement (large upfront cost but small ongoing costs afterwards – could be replacement with asphalt or concrete pavement)
- Pavement major rehabilitation until replacement (moderate upfront costs then small to moderate ongoing costs until replacement)
- Pavement minor rehabilitation until replacement (low upfront and ongoing costs until replacement)

The pavement LCCA model developed for the CPS reviews the characteristics of the candidate paving locations including the historical rehabilitation frequency to develop potential improvement strategies (full replacement, major rehabilitation until replacement, and minor rehabilitation until replacement, for either concrete or asphalt, as applicable). Each strategy consists of a set of corrective actions that contribute to keeping the pavement serviceable over the analysis period. The following assumptions are included in the pavement LCCA model:

- The pavement LCCA only addresses the condition of the pavement and does not address other issues or costs
- The historical pavement rehabilitation frequencies at each location are used to estimate future rehabilitation frequencies
- Different pavement replacement and rehabilitation strategies have different costs and expected service life

- The net present value of future costs is discounted at 3% and all dollar amounts are in 2015 dollars
- If the LCCA evaluation recommends rehabilitation or repair, the solution is not considered strategic and the rehabilitation will be addressed by normal programming processes
- Because this LCCA is conducted at a planning level, and due to the variabilities in costs and improvement strategies, the LCCA net present value results that are within 15% should be considered equally; in such a case, the solution should be carried forward as a strategic replacement project – more detailed scoping will confirm if replacement or rehabilitation is needed

Based on the candidate solutions presented in **Table 6**, LCCA was not conducted for any pavement sections on the SR 68/SR 95 North corridor, as noted in **Table 8**. Additional information regarding the pavement LCCA is contained in **Appendix E**.

Table 7: Bridge Life-Cycle Cost Analysis Results

Candidate Solution	Present Value at 3% Discount Rate ($)			Ratio of Present Value Compared to Lowest Present Value			Other Needs	Results
	Replace	Rehab	Repair	Replace	Rehab	Repair		
No LCCA conducted for any bridge candidate solutions on the SR 68/SR 95 North corridor								

Table 8: Pavement Life-Cycle Cost Analysis Results

Candidate Solution	Present Value at 3% Discount Rate ($)				Ratio of Present Value Compared to Lowest Present Value				Other Needs	Results
	Concrete Reconstruction	Asphalt Reconstruction	Asphalt Medium Rehabilitation	Asphalt Light Rehabilitation	Concrete Reconstruction	Asphalt Reconstruction	Asphalt Medium Rehabilitation	Asphalt Light Rehabilitation		
No LCCA conducted for any pavement candidate solutions on the SR 68/SR 95 North corridor										

5.2 Performance Effectiveness Evaluation

The results of the Performance Effectiveness Evaluation are combined with the results of a Performance Area Risk Analysis to determine a PES as defined in Section 5.0. The objectives of the Performance Effectiveness Evaluation include:

- Measure the benefit to the performance system versus the cost of the solution
- Include risk factors to help differentiate between similar solutions
- Apply to each performance area that is affected by the candidate solution
- Account for emphasis areas identified for the corridor

The Performance Effectiveness Evaluation includes the following steps:

- Estimate the post-solution performance for each of the five performance areas (Pavement, Bridge, Mobility, Safety, and Freight)
- Use the post-solution performance scores to calculate a post-solution level of need for each of the five performance areas
- Compare the pre-solution level of need to the post-solution level of need to determine the reduction in level of need (potential solution benefit) for each of the five performance areas
- Calculate performance area risk weighting factors for each of the five performance areas
- Use the reduction in level of need (benefit) and risk weighting factors to calculate the PES

Post-Solution Performance Estimation

For each performance area, a slightly different approach is used to estimate the post-solution performance. This process is based on the following assumptions:

- Pavement:
  - The IRI rating would decrease (to 30 for replacement or 45 for rehabilitation)
  - The Cracking rating would decrease (to 0 for replacement or rehabilitation)
- Bridge:
  - The structural ratings would increase (+1 for repair, +2 for rehabilitation, or increase to 8 for replacement)
  - The Sufficiency Rating would increase (+10 for repair, +20 for rehabilitation, or increase to 98 for replacement)
- Mobility:
  - Additional lanes would increase the capacity and therefore affect the Mobility Index and associated secondary measures
  - Other improvements (e.g., ramp metering, parallel ramps, variable speed limits) would also increase the capacity (to a lesser extent than additional lanes) and therefore would affect the Mobility Index and associated secondary measures
  - Changes in the Mobility Index (due to increased capacity) would have a direct effect on the TTI secondary measure
  - Changes in the Mobility Index (due to increased capacity) and Safety Index (due to crash reductions) would have a direct effect on the PTI secondary measure
  - Changes in the Safety Index (due to crash reductions) would have a direct effect on the Closure Extent secondary measure
- Safety:
  - Crash modification factors were developed that would be applied to estimate the reduction in crashes (for additional information see **Appendix F**)
- Freight:
  - Changes in the Mobility Index (due to increased capacity) and Safety Index (due to crash reductions) would have a direct effect on the Freight Index and the TPTI secondary measure
  - Changes in the Mobility Index (due to increased capacity) would have a direct effect on the TTTI secondary measure
  - Changes in the Safety Index (due to crash reductions) would have a direct effect on the Closure Duration secondary measure

Performance Area Risk Analysis

The Performance Area Risk Analysis is intended to develop a numeric risk weighting factor for each of the five performance areas (Pavement, Bridge, Mobility, Safety, and Freight). This risk analysis addresses other considerations for each performance area that are not directly included in the performance system. A risk weighting factor is calculated for each candidate solution based on the specific characteristics at the solution location. For example, the Pavement Risk Factor is based on factors such as the elevation, daily traffic volumes, and amount of truck traffic. Additional information regarding the Performance Area Risk Factors is included in **Appendix G**.

Following the calculation of the reduction in level of need (benefit) and the Performance Area Risk Factors, these values are used to calculate the PES. In addition, the reduction in level of need in each emphasis area is also included in the PES.

Net Present Value Factor

The benefit (reduction in need) is measured as a one-time benefit. However, different types of solutions will have varying service lives during which the benefits will be obtained. For example, a preservation solution would likely have a shorter stream of benefits over time when compared to a modernization or expansion solution. To address the varying lengths of benefit streams, each solution is classified as a 10-year, 20-year, 30-year, or 75-year benefit stream, or the net present value (NPV) factor (F_{NPV}). A 3% discount rate is used to calculate F_{NPV} for each classification of solution. The service lives and respective factors are described below:

- A 10-year service life is generally reflective of preservation solutions such as pavement and bridge preservation; these solutions would likely have a 10-year stream of benefits; for these solutions, a F_{NPV} of 8.8 is used in the PES calculation

- A 20-year service life is generally reflective of modernization solutions that do not include new infrastructure; these solutions would likely have a 20-year stream of benefits; for these solutions, a F_{NPV} of 15.3 is used in the PES calculation
- A 30-year service life is generally reflective of expansion solutions or modernization solutions that include new infrastructure; these solutions would likely have a 30-year stream of benefits; for these solutions, a F_{NPV} of 20.2 is used in the PES calculation
- A 75-year service life is used for bridge replacement solutions; these solutions would likely have a 75-year stream of benefits; for these solutions, a F_{NPV} of 30.6 is used in the PES calculation

Vehicle-Miles Travelled Factor

Another factor in assessing benefits is the number of travelers who would benefit from the implementation of the candidate solution. This factor varies between candidate solutions depending on the length of the solution and the magnitude of daily traffic volumes. Multiplying the solution length by the daily traffic volume results in vehicle-miles travelled (VMT), which provides a measure of the amount of traffic exposure that would receive the benefit of the proposed solution. The VMT is converted to a VMT factor (known as F_{VMT}), which is on a scale between 0 and 5, using the equation below:

$$F_{VMT} = 5 - (5 \times e^{VMT \times -0.0000139})$$

Performance Effectiveness Score

The PES is calculated using the following equation:

PES = ((Sum of all Risk Factored Benefit Scores + Sum of all Risk Factored Emphasis Area Scores) / Cost) x F_{VMT} x F_{NPV}

Where:

Risk Factored Benefit Score = Reduction in Segment-Level Need (benefit) x Performance Area Risk Weighting Factor (calculated for each performance area)

Risk Factored Emphasis Area Score = Reduction in Corridor-Level Need x Performance Area Risk Factors x Emphasis Area Factor (calculated for each emphasis area)

*Cost = estimated cost of candidate solution in millions of dollars (see **Appendix H**)*

F_{VMT} = Factor between 0 and 5 to account for VMT at location of candidate solution based on existing (2014) daily volume and length of solution

F_{NPV} = Factor (ranging from 8.8 to 30.6 as previously described) to address anticipated longevity of service life (and duration of benefits) for each candidate solution

The resulting PES values are shown in **Table 9**. Additional information regarding the calculation of the PES is contained in **Appendix I**.

For candidate solutions with multiple options to address Mobility, Safety, or Freight needs, the PES should be compared to help identify the best performing option. If one option clearly performs better than the other options (e.g., more than twice the PES value and a difference in magnitude of at least 20 points), the other options can be eliminated from further consideration. If multiple options have similar PES values, or there are other factors not accounted for in the performance system that could significantly influence the ultimate selection of an option (e.g., potential environmental concerns, potential adverse economic impacts), those options should all be advanced to the prioritization process. On the SR 68/SR 95 North corridor, the following candidate solution has options to address Mobility, Safety. or Freight needs:

- CS95N.1 (Options A and B) – Arizona Village Area Safety and Mobility Improvements
- CS68.5 (Options A and B) – Black Mountains Area Safety and Freight Improvements

Based on a review of the PES values for solutions CS95N.1 and CS68.5, both Option A and Option B for both solutions advanced to the candidate solution prioritization process and received a prioritization score.

Table 9: Performance Effectiveness Scores

Candidate Solution #	Segment #	Option	Candidate Solution Name	Milepost Location	Estimated Cost* (in millions)	Risk Factored Benefit Score					Risk Factored Emphasis Area Scores			Total Factored Benefit Score	F_{VMT}	F_{NPV}	Performance Effectiveness Score
						Pavement	Bridge	Mobility	Safety	Freight	Pavement	Safety	Mobility				
CS95N.1	95N-1	A	Arizona Village Area Safety and Mobility Improvements (widen and median)	226-227	$5.9	0.29	0.00	1.70	0.36	0.01	0.20	0.14	0.03	2.73	0.92	20.2	8.6
		B	Arizona Village Area Safety and Mobility Improvements (median)	226-227	$1.1	0.00	0.00	0.03	0.13	0.01	0.00	0.00	0.00	0.22	0.92	20.2	3.7
CS95N.2	95N-2	-	Fort Mohave Area Safety and Mobility Improvements	234-241	$10.9	0.00	0.00	2.88	8.73	0.65	0.00	1.71	0.04	14.01	3.54	20.2	91.6
CS95N.3	95N-3	-	Bullhead City Area Safety, Mobility, and Freight Improvements	241-250	$10.4	0.00	0.00	6.73	9.90	0.42	0.00	2.23	0.14	19.42	4.81	20.2	181.6
CS68.4	68-4	-	Sunridge Area Safety Improvements	0-7	$5.1	0.00	0.00	0.14	5.87	0.68	0.00	1.10	0.00	7.79	2.62	15.3	60.9
CS68.5A	68-5	A	Black Mountains Area Safety and Freight Improvements (cable barrier)	7-17	$5.6	0.00	0.00	1.01	11.02	1.59	0.00	2.69	0.00	16.31	1.18	15.3	53.0
		B	Black Mountains Area Safety and Freight Improvements (concrete barrier)	7-17	$9.1	0.00	0.00	1.14	13.05	1.80	0.00	3.06	0.00	19.06	1.18	15.3	37.9
CS68.6	68-6	-	West Golden Valley Area Safety and Freight Improvements	17-22	$20.2	0.00	0.00	0.055	1.92	1.24	0.00	0.24	0.00	3.45	2.40	20.2	8.3
CS68.7	68-7	-	East Golden Valley Area Safety Improvements	22-27	$19.8	0.00	0.00	0.498	2.73	1.47	0.00	0.34	0.00	5.04	2.67	20.2	13.8

*: See Table 11 for total construction costs

5.3 Solution Risk Analysis

Following the calculation of the PES, an additional step is taken to develop the prioritized list of solutions. A solution risk probability and consequence analysis is conducted to develop a solution-level risk weighting factor. This risk analysis is a numeric scoring system to help address the risk of not implementing a solution based on the likelihood and severity of performance failure. **Figure 11** shows the risk matrix used to develop the risk weighting factors.

Figure 11: Risk Matrix

		Severity/Consequence				
		Insignificant	**Minor**	**Significant**	**Major**	**Catastrophic**
Frequency/ Likelihood	**Very Rare**	Low	Low	Low	Moderate	Major
	Rare	Low	Low	Moderate	Major	Major
	Seldom	Low	Moderate	Moderate	Major	Severe
	Common	Moderate	Moderate	Major	Severe	Severe
	Frequent	Moderate	Major	Severe	Severe	Severe

Using the risk matrix in **Figure 11**, numeric values were assigned to each category of frequency and severity. The higher the risk, the higher the numeric factor that was assigned. The risk weight for each area of the matrix was calculated by multiplying the severity factor times the frequency factor. These numeric factors are shown in **Figure 12**.

Figure 12: Numeric Risk Matrix

			Severity/Consequence				
			Insignificant	**Minor**	**Significant**	**Major**	**Catastrophic**
		Weight	1.00	1.10	1.20	1.30	1.40
Frequency/ Likelihood	**Very Rare**	1.00	1.00	1.10	1.20	1.30	1.40
	Rare	1.10	1.10	1.21	1.32	1.43	1.54
	Seldom	1.20	1.20	1.32	1.44	1.56	1.68
	Common	1.30	1.30	1.43	1.56	1.69	1.82
	Frequent	1.40	1.40	1.54	1.68	1.82	1.96

Using the values in **Figure 12**, risk weighting factors were calculated for each of the following four risk categories: low, moderate, major, and severe. These values are simply the average of the values in **Figure 12** that fall within each category. The resulting average risk weighting factors are:

Low	Moderate	Major	Severe
1.14	1.36	1.51	1.78

The risk weighting factors listed above are assigned to the five performance areas as follows:

- Safety = 1.78
  - The Safety performance area quantifies the likelihood of fatal or incapacitating injury crashes; therefore, it is assigned the Severe (1.78) risk weighting factor
- Bridge = 1.51
  - The Bridge performance area focuses on the structural adequacy of bridges; a bridge failure may result in crashes or traffic being detoured for long periods of time resulting in significant travel time increases; therefore, it is assigned the Major (1.51) risk weighting factor
- Mobility and Freight = 1.36
  - The Mobility and Freight performance areas focus on capacity and congestion; failure in either of these performance areas would result in increased travel times but would not have significant effect on safety (crashes) that would not already be addressed in the Safety performance area; therefore, they are assigned the Moderate (1.36) risk weighing factor
- Pavement = 1.14
  - The Pavement performance area focuses on the ride quality of the pavement; failure in this performance area would likely be a spot location that would not dramatically affect drivers beyond what is already captured in the Safety performance area; therefore, it is assigned the Low (1.14) risk weighting factor

The benefit in each performance area is calculated for each candidate solution as part of the Performance Effectiveness Evaluation. Using this information on benefits and the risk factors listed above, a weighted (based on benefit) solution-level numeric risk factor is calculated for each candidate solution. For example, a solution that has 50% of its benefit in Safety and 50% of its benefit in Mobility has a weighted risk factor of 1.57 (0.50 x 1.36 + 0.50 x 1.78 = 1.57).

5.4 Candidate Solution Prioritization

The PES, weighted risk factor, and segment average need score are combined to create a prioritization score as follows:

Prioritization Score = PES x Weighted Risk Factor x Segment Average Need Score

Where:

*PES = Performance Effectiveness Score as shown in **Table 9***

Weighted Risk Factor = Weighted factor to address risk of not implementing a solution based on the likelihood and severity of the performance failure

*Segment Average Need Score = Segment average need score as shown in **Table 4***

Table 10 shows the prioritization scores for the candidate solutions subjected to the solution evaluation and prioritization process. Solutions that address multiple performance areas tend to score higher in this process. A prioritized list of candidate solutions is provided in the subsequent section. See **Appendix J** for additional information on the prioritization process.

Table 10: Prioritization Scores

Candidate Solution #	Segment #	Option	Candidate Solution Name	Milepost Location	Estimated Cost (in millions)	Performance Effectiveness Score	Weighted Risk Factor	Segment Average Need Score	Prioritization Score	Percentage by which Solution Reduces Performance Area Segment Needs				
										Pavement	Bridge	Mobility	Safety	Freight
CS95N.1	95N-1	A	Arizona Village Area Safety and Mobility Improvements (widen and median)	226-227	$5.9	8.6	1.40	1.38	**17**	28%	0%	23%	8%	3%
		B	Arizona Village Area Safety and Mobility Improvements (median)	226-227	$1.1	3.7	1.72	1.38	**9**	0%	0%	0%	3%	1%
CS95N.2	95N-2	-	Fort Mohave Area Safety and Mobility Improvements	234-241	$10.9	91.6	1.67	2.00	**307**	0%	0%	27%	22%	16%
CS95N.3	95N-3	-	Bullhead City Area Safety, Mobility, and Freight Improvements	241-250	$10.4	181.6	1.62	2.54	**748**	0%	0%	27%	27%	5%
CS68.4	68-4	-	Sunridge Area Safety Improvements	0-7	$5.1	60.9	1.74	1.08	**114**	0%	0%	4%	51%	19%
CS68.5	68-5	A	Black Mountains Area Safety and Freight Improvements (cable barrier)	7-17	$5.6	53.0	1.71	1.38	**126**	0%	0%	23%	52%	6%
		B	Black Mountains Area Safety and Freight Improvements (concrete barrier)	7-17	$9.1	37.9	1.72	1.38	**90**	0%	0%	26%	61%	7%
CS68.6	68-6	-	West Golden Valley Area Safety and Freight Improvements	17-22	$20.2	24.8	1.45	1.62	**22**	0%	0%	6%	24%	11%
CS68.7	68-7	-	East Golden Valley Area Safety Improvements	22-27	$19.8	19.3	1.54	1.08	**24**	0%	0%	18%	25%	34%

6.0 SUMMARY OF CORRIDOR RECOMMENDATIONS

6.1 Prioritized Candidate Solution Recommendations

Table 11 and **Figure 13** show the prioritized candidate solutions recommended for the SR 68/SR 95 North corridor in ranked order of priority. The highest prioritization score indicates the candidate solution that is recommended as the highest priority. Implementation of these solutions is anticipated to improve performance of the SR 68/SR 95 North corridor. The following observations were noted about the prioritized solutions:

- Most of the anticipated improvements in performance are in the Mobility, Safety, and Freight performance areas
- The highest ranking solutions tend to have overlapping benefits in the Mobility, Safety, and Freight performance areas
- The highest priority solutions address needs in the Bullhead City area (SR 95 MP 241-250), Fort Mohave area (SR 95 MP 234-241) and near the Black Mountains area between Bullhead City and Golden Valley (SR 68 MP 7-17)

6.2 Other Corridor Recommendations

As part of the investigation of strategic investment areas and candidate solutions, other corridor recommendations can also be identified. These recommendations could include modifications to the existing Statewide Construction Program, areas for further study, or other corridor-specific recommendations that are not related to construction or policy. The list below identifies other corridor recommendations for the SR 68/SR 95 North corridor:

- A series of RSAs is recommended along the SR 95 corridor at MP 229.4-246.0. The RSAs should include a review of pedestrian crossing behaviors and current access control. An RSA was completed for MP 242-250 in October 2008. Recommendations should be reviewed and updated with an emphasis on pedestrian safety
- Local policy should be implemented to require new developments to provide sidewalk along SR 95 North frontage through Fort Mohave and Bullhead City
- Increased enforcement is recommended related to motorists failing to yield the right-of-way at intersections and for pedestrians crossing improperly on SR 95 North through Fort Mohave and Bullhead City. A pedestrian safety campaign should be implemented that includes providing local businesses with ADOT pedestrian safety pamphlets

6.3 Policy and Initiative Recommendations

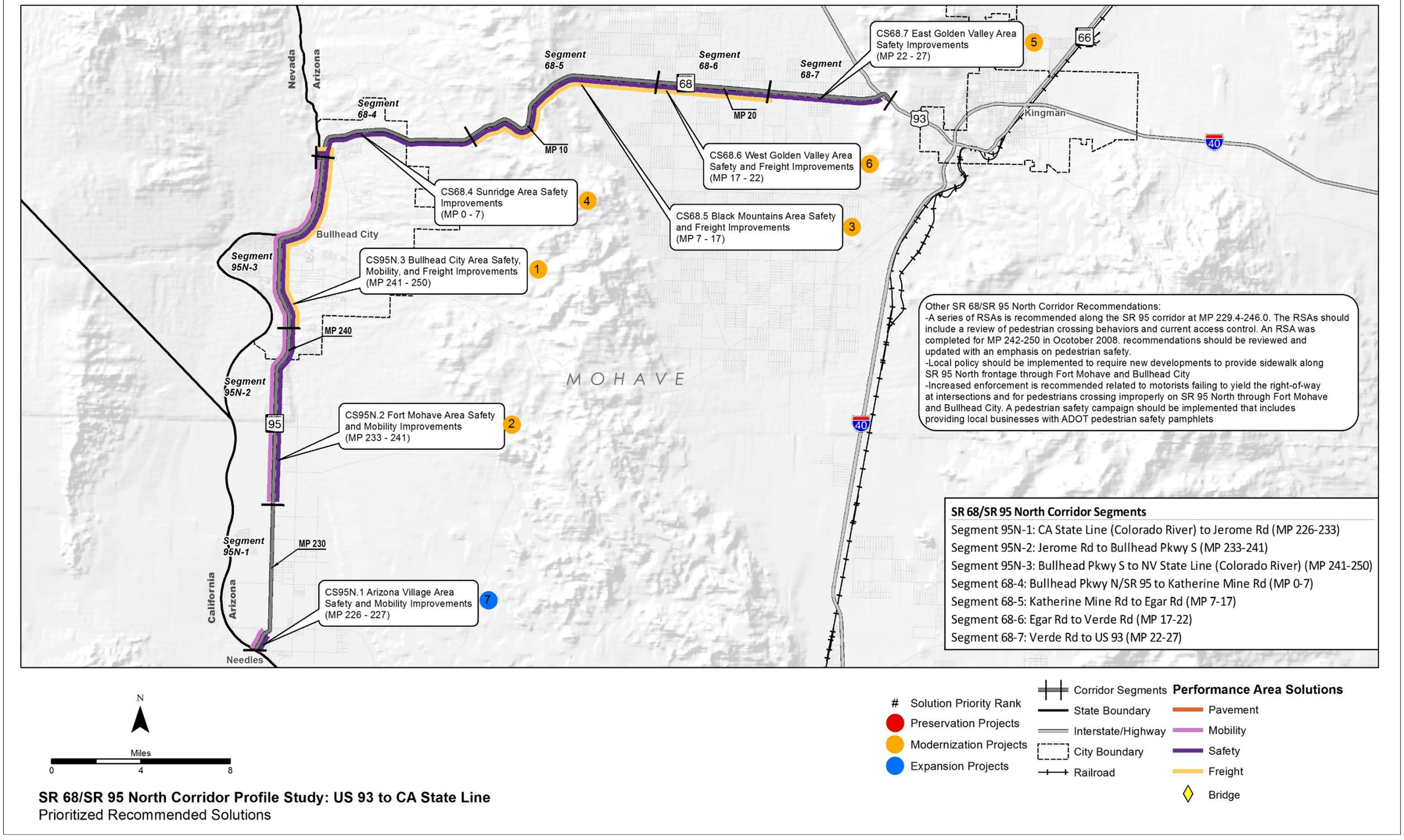
In addition to location-specific needs, general corridor and system-wide needs have also been identified through the CPS process. While these needs are more overarching and cannot be individually evaluated through this process, it is important to document them. A list of recommended policies and initiatives was developed for consideration when programming future projects not only on the SR 68/SR 95 North corridor, but across the entire state highway system where the conditions are applicable. The following list, which is in no particular order of priority, was derived from the Round 1, Round 2, and Round 3 CPS:

- Install Intelligent Transportation System (ITS) conduit with all new infrastructure projects
- Prepare strategic plans for Closed Circuit Television (CCTV) camera and Road Weather Information System (RWIS) locations statewide
- Leverage power and communication at existing weigh-in-motion (WIM), dynamic message signs (DMS), and call box locations to expand ITS applications across the state
- Consider solar power for lighting and ITS where applicable
- Investigate ice formation prediction technology where applicable
- Conduct highway safety manual evaluation for all future programmed projects
- Develop infrastructure maintenance and preservation plans (including schedule and funding) for all pavement and bridge infrastructure replacement or expansion projects
- Develop standardized bridge maintenance procedures so districts can do routine maintenance work
- Review historical ratings and level of previous investment during scoping of pavement and bridge projects. In pavement locations that warrant further investigation, conduct subsurface investigations during project scoping to determine if full replacement is warranted
- For pavement rehabilitation projects, enhance the amount/level of geotechnical investigations to address issues specific to the varying conditions along the project
- Expand programmed and future pavement projects as necessary to include shoulders
- Expand median cable barrier guidelines to account for safety performance
- Install CCTV cameras with all DMS
- In locations with limited communications, use CCTV cameras to provide still images rather than streaming video
- Develop statewide program for pavement replacement
- Install additional continuous permanent count stations along strategic corridors to enhance traffic count data
- When reconstruction or rehabilitation activities will affect existing bridge vertical clearance, the dimension of the new bridge vertical clearance should be a minimum of 16.25 feet where feasible
- All new or reconstructed roadway/shoulder edges adjacent to an unpaved surface should be constructed with a Safety Edge
- Collision data on tribal lands may be incomplete or inconsistent; additional coordination for data on tribal lands is required to ensure adequate reflection of safety issues
- Expand data collection devices statewide to measure freight delay
- Evaluate and accommodate potential changes in freight and goods movement trends that may result from improvements and expansions to the state roadway network

Table 11: Prioritized Recommended Solutions

Rank	Candidate Solution #	Option	Solution Name and Location	Description / Scope	Estimated Cost (in millions)	Investment Category (Preservation [P], Modernization [M], Expansion [E])	Prioritization Score
1	CS95N.3	-	Bullhead City Area Safety, Mobility, and Freight Improvements (MP 241-250)	-Construct raised median from north of Bullhead Parkway South (MP 241.0) to Aviation Way (MP 249.5) -Implement signal coordination from Mohave Community College access (MP 241.1) to Bullhead Parkway North (MP 249.8), a total of 18 signals -Improve signal visibility at Mohave Drive (MP 242.8) and Ramar Road (MP 244.9) -Construct SB right-turn lanes at Marina Blvd (MP 243.9) and Thunderstruck Drive (244.2) -Implement protected left-turn phasing at Hancock Road (MP 244.3) -Install sidewalk on the west side of SR 95, MP 241.0-241.7 and 242.2-242.8	$10.4	M	748
2	CS95N.2	-	Fort Mohave Area Safety and Mobility Improvements (MP 234-241)	-Implement signal coordination from Boundary Cone Road (MP 234.4) to Bullhead Parkway South (MP 240.7), a total of 9 signals -Improve signal visibility at Boundary Cone Road (MP 234.4) and El Rodeo Drive (MP 237.4) intersections -Construct raised median, sidewalks, curb, and gutter, where not existing, from south of Lipan Blvd (MP 235.0) to Teller Lane (MP 237.1) -Provide continuous lighting on both sides of the roadway from south of Lipan Blvd (MP 235.0) through El Rodeo Drive (MP 237.4) and Valencia Road (MP 238.9) to Sterling Road (MP 239.5) -Construct traffic signal at Chaparral Road (MP 236.2) -Construct raised median, sidewalks, curb, and gutter, where not existing, from Valencia Road (MP 238.9) to north of Bullhead Parkway South (MP 241.0) -Construct traffic signal at Corwin Road (MP 239.9)	$10.9	M	307
3	CS68.5	A	Black Mountains Area Safety and Freight Improvements (MP 7-17) (cable barrier)	-Install cable median barrier, MP 8.6-11.1 -Rehabilitate shoulders in both directions (striping, delineators, RPMs, safety edge, and rumble strips for both shoulders), MP 7.0-17.0 -Install speed feedback signs, EB MP 8.6 and WB MP 11.1 -Install curve warning signs with flashing beacons and chevrons (both directions), MPs 8.6-9.1 and 10.6-11.1	$5.6	M	126
		B	*Black Mountains Area Safety and Freight Improvements (MP 7-17) (concrete barrier)*	*-Install raised concrete barrier in median, MP 8.6-11.1* *-Rehabilitate shoulders in both directions (striping, delineators, RPMs, safety edge, and rumble strips for both shoulders), MP 7.0-17.0* *-Install speed feedback signs, EB MP 8.6 and WB MP 11.1* *-Install curve warning signs with flashing beacons and chevrons (both directions), MPs 8.6-9.1 and 10.6-11.1*	*$9.1*	*M*	*90*
4	CS68.4	-	Sunridge Area Safety Improvements (MP 0-7)	-Improve delineation in both directions (striping, delineators, and RPMs), MP 0.0-1.3 -Install curve warning signs and chevrons (both directions), MPs 0.6-0.9, 4.1-4.6, and 6.5-6.9 -Rehabilitate shoulders in both directions (striping, delineators, RPMs, safety edge, and rumble strips for both shoulders), MP 1.3-7.0 -Construct raised median, MP 2.1-2.6 -Install lighting (both directions), MP 2.1-3.0	$5.1	M	114
5	CS68.7	-	East Golden Valley Area Safety Improvements (MP 22-27)	-Construct raised median, MP 22.0-26.8 -Construct double-lane roundabouts at the following locations: Adobe Road (MP 22.8), Aztec Road (MP 23.8), and Bacobi Road (MP 24.8) -Provide lighting at Adobe Road intersection, and from MP 23.7-24.9 and MP 25.3-26.7	$19.8	M	24
6	CS68.6	-	West Golden Valley Area Safety and Freight Improvements (MP 17-22)	-Construct indirect left-turn improvements at Egar Road (MP 16.8) and Estrella Road (MP 17.8) with a raised median in between -Construct left-in only raised median improvements at Milky Way Road (MP 18.7) -Construct indirect left-turn improvement with a raised median at Teddy Roosevelt Road (MP 19.8) -Construct double-lane roundabouts at Colorado Road (MP 20.8) and Verde Road (MP 21.8) with a raised median, MP 20.8-22.0 -Provide lighting at major intersections (6 total including Egar, Estrella, Milky Way, Teddy Roosevelt, Colorado, and Verde), MP 16.8-22.0	$20.2	M	22
7	CS95N.1	A	Arizona Village Area Safety and Mobility Improvements (MP 226-227) (widen and median)	-Convert to a 4-lane highway with raised median, Colorado River Bridge (MP 226.1) to Courtwright Road (MP 227.3)	$5.9	E	17
		B	*Arizona Village Area Safety and Mobility Improvements (MP 226-227) (median)*	*-Construct raised median, Colorado River Bridge (MP 226.1) to Courtwright Road (MP 227.3)*	*$1.1*	*M*	*9*

Figure 13: Prioritized Recommended Solutions



SR 68/SR 95 North Corridor Profile Study: US 93 to CA State Line
Prioritized Recommended Solutions

6.4 Next Steps

The candidate solutions recommended in this study are not intended to be a substitute or replacement for traditional ADOT project development processes where various ADOT technical groups and districts develop candidate projects for consideration in the performance-based programming in the P2P process. Rather, these candidate solutions are intended to complement ADOT's traditional project development processes through a performance-based process to address needs in one or more of the five performance areas of Pavement, Bridge, Mobility, Safety, and Freight. Candidate solutions developed for the SR 68/SR 95 North corridor will be considered along with other candidate projects in the ADOT statewide programming process.

It is important to note that the candidate solutions are intended to represent strategic solutions to address existing performance needs related to the Pavement, Bridge, Mobility, Safety, and Freight performance areas. Therefore, the strategic solutions are not intended to preclude recommendations related to the ultimate vision for the corridor that may have been defined in the context of prior planning studies and/or design concept reports. Recommendations from such studies are still relevant to addressing the ultimate corridor objectives.

Upon completion of all four CPS rounds, the results will be incorporated into a summary document comparing all corridors that is expected to provide a performance-based review of statewide needs and candidate solutions.

Appendix A: Corridor Performance Maps

Appendix A was provided in the previously submitted Draft Report: Performance and Needs Evaluation

Appendix B: Performance Area Detailed Calculation Methodologies

Appendix B was provided in the previously submitted Draft Report: Performance and Needs Evaluation

Appendix C: Performance Area Data

Appendix C was provided in the previously submitted Draft Report: Performance and Needs Evaluation

Appendix D: Needs Analysis Contributing Factors and Scores

Appendix D was provided in the previously submitted Draft Report: Performance and Needs Evaluation

Appendix E: Life-Cycle Cost Analysis

No LCCA conducted for any Pavement or Bridge candidate solutions on the SR 68/SR 95 North corridor

Appendix F: Crash Modification Factors and Factored Unit Construction Costs

SOLUTION	CONSTRUCTION UNIT COST	UNIT	FACTOR^	FACTORED CONSTRUCTION UNIT COST	DESCRIPTION	CMF FOR CORRIDOR PROFILE STUDIES	CMF NOTES
REHABILITATION							
Rehabilitate Pavement (AC)	$276,500	Mile	2.20	$610,000	Mill and replace 1"-3" AC pavement; accounts for 38' width; for one direction of travel on two-lane roadway; includes pavement, striping, delineators, RPMs, rumble strips	0.70	Combination of rehabilitate pavement (0.92), striping, delineators, RPMs (0.77 for combination), and rumble strips (0.89) = 0.70
Rehabilitate Bridge	$65	SF	2.20	$140	Based on deck area; bridge only - no other costs included	0.95	Assumed - should have a minor effect on crashes at the bridge
GEOMETRIC IMPROVEMENT							
Re-profile Roadway	$974,500	Mile	2.20	$2,140,000	Includes excavation of approximately 3", pavement replacement (AC), striping, delineators, RPMs, rumble strips, for one direction of travel on two-lane roadway (38' width)	0.70	Assumed - this is similar to rehab pavement. This solution is intended to address vertical clearance at bridge, not profile issue; factor the cost as a ratio of needed depth to 3".
Realign Roadway	$2,960,000	Mile	2.20	$6,510,000	All costs per direction except bridges; applicable to areas with small or moderate fills and cuts, minimal retaining walls	0.50	Based on Caltrans and NCDOT
Improve Skid Resistance	$675,000	Mile	2.20	$1,490,000	Average cost of pavement replacement and variable depth paving to increase super-elevation; for one direction of travel on two-lane roadway; includes pavement, striping, delineators, RPMs, rumble strips	0.66	Combination of average of 5 values from clearinghouse (0.77) and calculated value from HSM (0.87) for skid resistance; striping, delineators, RPMs (0.77 for combination), and rumble strips (0.89) = 0.66
INFRASTRUCTURE IMPROVEMENT							
Reconstruct to Urban Section	$1,000,000	Mile	2.20	$2,200,000	Includes widening by 16' total (AC = 12'+2'+2') to provide median, curb & gutter along both side of roadway, single curb for median, striping (doesn't include widening for additional travel lane).	0.88	From HSM
Construct Auxiliary Lanes (AC)	$914,000	Mile	2.20	$2,011,000	For addition of aux lane (AC) in one direction of travel; includes all costs except bridges; for generally at-grade facility with minimal walls and no major drainage improvements	0.78	Average of 4 values from clearinghouse
Construct Climbing Lane (High)	$3,000,000	Mile	2.20	$6,600,000	In one direction; all costs except bridges; applicable to areas with large fills and cuts, retaining walls, rock blasting, steep slopes on both sides of road	0.75	From HSM

SOLUTION	CONSTRUCTION UNIT COST	UNIT	FACTOR^	FACTORED CONSTRUCTION UNIT COST	DESCRIPTION	CMF FOR CORRIDOR PROFILE STUDIES	CMF NOTES
Construct Climbing Lane (Medium)	$2,250,000	Mile	2.20	$4,950,000	In one direction; all costs except bridges; applicable to areas with medium or large fills and cuts, retaining walls, rock blasting, steep slopes on one side of road	0.75	From HSM
Construct Climbing Lane (Low)	$1,500,000	Mile	2.20	$3,300,000	In one direction; all costs except bridges; applicable to areas with small or moderate fills and cuts, minimal retaining walls	0.75	From HSM
Construct Reversible Lane (Low)	$2,400,000	Lane-Mile	2.20	$5,280,000	All costs except bridges; applicable to areas with small or moderate fills and cuts, minimal retaining walls	0.73 for uphill and 0.88 for downhill	Based on proposed conditions on I-17 with 2 reversible lanes and a concrete barrier
Construct Reversible Lane (High)	$4,800,000	Lane-Mile	2.20	$10,560,000	All costs except bridges; applicable to areas with large fills and cuts, retaining walls, rock blasting, mountainous terrain	0.73 for uphill and 0.88 for downhill	Based on proposed conditions on I-17 with 2 reversible lanes and a concrete barrier
Construct Passing Lane	$1,500,000	Mile	2.20	$3,300,000	In one direction; all costs except bridges; applicable to areas with small or moderate fills and cuts, minimal retaining walls	0.63	Average of 3 values from clearinghouse
Construct Entry/Exit Ramp	$730,000	Each	2.20	$1,610,000	Cost per ramp; includes pavement, striping, signing, RPMs, lighting, typical earthwork & drainage; does not include any major structures or improvements on crossroad	1.09	Average of 16 values on clearinghouse; for adding a ramp not reconstructing. CMF applied to crashes 0.25 miles upstream/downstream from the gore.
Relocate Entry/Exit Ramp	$765,000	Each	2.20	$1,680,000	Cost per ramp; includes pavement, striping, signing, RPMs, lighting, typical earthwork, drainage and demolition of existing ramp; does not include any major structures or improvements on crossroad	1.00	Assumed to not add any crashes since the ramp is simply moving and not being added. CMF applied to crashes 0.25 miles upstream/downstream from the gore.
Construct Turn Lanes	$42,500	Each	2.20	$93,500	Includes 14' roadway widening (AC) for one additional turn lane (250' long) on one leg of an intersection; includes AC pavement, curb & gutter, sidewalk, ramps, striping, and minor signal modifications	0.81	Average of 7 values from HSM; CMF applied to intersection related crashes; this solution also applies when installing a deceleration lane
Modify Entry/Exit Ramp	$445,000	Each	2.20	$979,000	Cost per ramp; includes pavement, striping, signing, RPMs, lighting, minor earthwork, & drainage; For converting existing ramp to parallel-type configuration	0.21	Average of 4 values from clearinghouse (for exit ramps) and equation from HSM (for entrance ramp). CMF applied to crashes within 1/8 mile upstream/downstream from the gore.
Widen & Modify Entry/Exit Ramp	$619,000	Each	2.20	$1,361,800	Cost per ramp; includes pavement, striping, signing, RPMs, lighting, minor earthwork, & drainage; For converting 1-lane ramp to 2-lane ramp and converting to parallel-type ramp	0.21	Will be same as "Modify Ramp"

SOLUTION	CONSTRUCTION UNIT COST	UNIT	FACTOR^	FACTORED CONSTRUCTION UNIT COST	DESCRIPTION	CMF FOR CORRIDOR PROFILE STUDIES	CMF NOTES
Replace Pavement (AC) (with overexcavation)	$1,446,500	Mile	2.20	$3,180,000	Accounts for 38' width; for one direction of travel on two-lane roadway; includes pavement, overexcavation, striping, delineators, RPMs, rumble strips	0.70	Same as rehab
Replace Pavement (PCCP) (with overexcavation)	$1,736,500	Mile	2.20	$3,820,000	Accounts for 38' width; for one direction of travel on two-lane roadway; includes pavement, overexcavation, striping, delineators, RPMs, rumble strips	0.70	Same as rehab
Replace Bridge (Short)	$125	SF	2.20	$280	Based on deck area; bridge only - no other costs included; cost developed generally applies to bridges crossing small washes	0.95	Assumed - should have a minor effect on crashes at the bridge
Replace Bridge (Medium)	$160	SF	2.20	$350	Based on deck area; bridge only - no other costs included; cost developed generally applies to bridges crossing over the mainline freeway, crossroads, or large washes	0.95	Assumed - should have a minor effect on crashes at the bridge
Replace Bridge (Long)	$180	SF	2.20	$400	Based on deck area; bridge only - no other costs included; cost developed generally applies to bridges crossing large rivers or canyons	0.95	Assumed - should have a minor effect on crashes at the bridge
Widen Bridge	$175	SF	2.20	$390	Based on deck area; bridge only - no other costs included	0.90	Assumed - should have a minor effect on crashes at the bridge
Install Pedestrian Bridge	$135	SF	2.20	$300	Includes cost to construct bridge based on linear feet of the bridge. This cost includes and assumes ramps and sidewalks leading to the structure.	0.1 (pedestrian only)	Assumed direct access on both sides of structure
Implement Automated Bridge De-icing	$115	SF	2.20	$250	Includes cost to replace bridge deck and install system	0.72 (snow/ice)	Average of 3 values on clearinghouse for snow/ice
Install Wildlife Crossing Under Roadway	$650,000	Each	2.20	$1,430,000	Includes cost of structure for wildlife crossing under roadway and 1 mile of fencing in each direction that is centered on the wildlife crossing	0.25 (wildlife)	Assumed; CMF applies to wildlife-related crashes within 0.5 miles both upstream and downstream of the wildlife crossing in both directions
Install Wildlife Crossing Over Roadway	$1,140,000	Each	2.20	$2,508,000	Includes cost of structure for wildlife crossing over roadway and 1 mile of fencing in each direction that is centered on the wildlife crossing	0.25 (wildlife)	Assumed; CMF applies to wildlife-related crashes within 0.5 miles both upstream and downstream of the wildlife crossing in both directions
Construct Drainage Structure - Minor	$280,000	Each	2.20	$616,000	Includes 3-36" pipes and roadway reconstruction (approx. 1,000 ft) to install pipes	0.70	Same as rehab; CMF applied to crashes 1/8 mile upstream/downstream of the structure
Construct Drainage Structure - Intermediate	$540,000	Each	2.20	$1,188,000	Includes 5 barrel 8'x6' RCBC and roadway reconstruction (approx. 1,000 ft) to install RCBC	0.70	Same as rehab; CMF applied to crashes 1/8 mile upstream/downstream of the structure

SOLUTION	CONSTRUCTION UNIT COST	UNIT	FACTOR^	FACTORED CONSTRUCTION UNIT COST	DESCRIPTION	CMF FOR CORRIDOR PROFILE STUDIES	CMF NOTES
Construct Drainage Structure - Major	$8,000	LF	2.20	$17,600	Includes bridge that is 40' wide and reconstruction of approx. 500' on each approach	0.70	Same as rehab; CMF applied to crashes 1/8 mile upstream/downstream of the structure
Install Acceleration Lane	$127,500	Each	2.20	$280,500	For addition of an acceleration lane (AC) on one leg of an intersection that is 1,000' long plus a taper; includes all costs except bridges; for generally at-grade facility with minimal walls and no major drainage improvements	0.85	Average of 6 values from the FHWA Desktop Reference for Crash Reduction Factors
OPERATIONAL IMPROVEMENT							
Implement Variable Speed Limits (Wireless, Overhead)	$718,900	Mile	2.20	$1,580,000	In one direction; includes 1 sign assembly per mile (foundation and structure), wireless communication, detectors	0.92	From 1 value from clearinghouse
Implement Variable Speed Limits (Wireless, Ground-mount)	$169,700	Mile	2.20	$373,300	In one direction; includes 2 signs per mile (foundations and posts), wireless communication, detectors	0.92	From 1 value from clearinghouse
Implement Variable Speed Limits (Wireless, Solar, Overhead)	$502,300	Mile	2.20	$1,110,000	In one direction; includes 1 sign assembly per mile (foundation and structure), wireless communication, detectors, solar power	0.92	From 1 value from clearinghouse
Implement Variable Speed Limits (Wireless, Solar, Ground-mount)	$88,400	Mile	2.20	$194,500	In one direction; includes 2 signs per mile (foundations and posts), wireless communication, detectors, solar power	0.92	From 1 value from clearinghouse
Implement Ramp Metering (Low)	$25,000	Each	2.20	$55,000	For each entry ramp location; urban area with existing ITS backbone infrastructure; includes signals, poles, timer, pull boxes, etc.	0.64	From 1 value from clearinghouse; CMF applied to crashes 0.25 miles after gore
Implement Ramp Metering (High)	$150,000	Mile	2.20	$330,000	Area without existing ITS backbone infrastructure; in addition to ramp meters, also includes conduit, fiber optic lines, and power	0.64	From 1 value from clearinghouse
Implement Signal Coordination	$140,000	Mile	2.20	$308,000	Includes conduit, conductors, and controllers for 4 intersections that span a total of approximately 2 miles	0.90	Assumed

SOLUTION	CONSTRUCTION UNIT COST	UNIT	FACTOR^	FACTORED CONSTRUCTION UNIT COST	DESCRIPTION	CMF FOR CORRIDOR PROFILE STUDIES	CMF NOTES
Implement Left-Turn Phasing	$7,500	Each	2.20	$16,500	Includes four new signal heads (two in each direction) and associated conductors for one intersection	0.88 (protected) 0.98 (permitted/protected or protected/permitted)	From HSM; CMF = 0.94 for each protected approach and 0.99 for each permitted/protected or protected/permitted approach. CMFs of different approaches should be multiplied together. CMF applied to crashes within intersection
ROADSIDE DESIGN							
Install Guardrail	$130,000	Mile	2.20	$286,000	One side of road	0.62 (ROR)	0.62 is average of 2 values from clearinghouse
Install Cable Barrier	$80,000	Mile	2.20	$176,000	In median	0.81	0.81 is average of 5 values from clearinghouse
Widen Shoulder (AC)	$256,000	Mile	2.20	$563,000	Assumes 10' of existing shoulder (combined left and right), includes widening shoulder by a total of 4'; new pavement for 4' width and mill and replace existing 10' width; includes pavement, minor earthwork, striping edge lines, RPMs, high-visibility delineators, safety edge, and rumble strips	0.68 (1-4') 0.64 (>= 4')	0.86 is average of 5 values from clearing house for widening shoulder 1-4'. 0.76 is calculated from HSM for widening shoulder >= 4'. (Cost needs to be updated if dimension of existing and widened shoulder differ from Description.)
Rehabilitate Shoulder (AC)	$113,000	Mile	2.20	$249,000	One direction of travel (14' total shoulder width-4' left and 10' right); includes paving (mill and replace), striping, high-visibility delineators, RPMs, safety edge, and rumble strips for both shoulders	0.72	0.98 is average of 34 values on clearinghouse for shoulder rehab/replace; include striping, delineators, RPMs (0.77 combined CMF), and rumble strips (0.89). (Cost needs to be updated if dimension of existing shoulder differs from Description.)
Replace Shoulder (AC)	$364,000	Mile	2.20	$801,000	One direction of travel (14' total shoulder width-4' left and 10' right); includes paving (full reconstruction), striping, high-visibility delineators, RPMs, safety edge, and rumble strips for both shoulders	0.72	0.98 is average of 34 values on clearinghouse for shoulder rehab/replace; include striping, delineators, RPMs (0.77 combined CMF), and rumble strips (0.89). (Cost needs to be updated if dimension of existing shoulder differs from Description.)
Install Rumble Strip	$5,500	Mile	2.20	$12,000	Both edges - one direction of travel; includes only rumble strip; no shoulder rehab or paving or striping	0.89	Average of 75 values on clearinghouse and consistent with HSM
Install Centerline Rumble Strip	$2,800	Mile	2.20	$6,000	Includes rumble strip only; no pavement rehab or striping	0.85	From HSM

SOLUTION	CONSTRUCTION UNIT COST	UNIT	FACTOR^	FACTORED CONSTRUCTION UNIT COST	DESCRIPTION	CMF FOR CORRIDOR PROFILE STUDIES	CMF NOTES
Install Wildlife Fencing	$340,000	Mile	2.20	$748,000	Fencing only plus jump outs for 1 mile (both directions)	0.50 (wildlife)	Assumed
Remove Tree/Vegetation	$200,000	Mile	2.20	$440,000	Intended for removing trees that shade the roadway to allow sunlight to help melt snow and ice (see Increase Clear Zone CMF for general tree/vegetation removal in clear zone)	0.72 (snow/ice)	Average of 3 values on clearinghouse for snow/ice
Increase Clear Zone	$59,000	Mile	2.20	$130,000	In one direction; includes widening the clear zone by 10' to a depth of 3'	0.71	Median of 14 values from FHWA Desktop Reference for Crash Reduction Values
Install Access Barrier Fence	$15	LF	2.20	$33	8' fencing along residential section of roadway	0.10 (pedestrian only)	Equal to pedestrian overpass
Install Rock-Fall Mitigation - Wire Mesh	$1,320,000	Mile	2.20	$2,904,000	Includes wire mesh and rock stabilization (one direction)	0.75 (debris)	Assumed
Install Rock-Fall Mitigation - Containment Fence & Barrier	$2,112,000	Mile	2.20	$4,646,000	Includes containment fencing, concrete barrier, and rock stabilization (one direction)	0.75 (debris)	Assumed
Install Raised Concrete Barrier in Median	$650,000	Mile	2.20	$1,430,000	Includes concrete barrier with associated striping and reflective markings; excludes lighting in barrier (one direction)	0.90 (Cross-median and head-on crashes eliminated completely)	All cross median and head-on fatal or incapacitating injury crashes are eliminated completely; all remaining crashes have 0.90 applied
Formalize Pullout (Small)	$7,500	Each	2.20	$17,000	Includes paving and signage (signs, posts, and foundations) - approximately 4,200 sf	0.97	Assumed - similar to Install Other General Warning Signs; CMF applied to crashes within 0.25 miles after sign
Formalize Pullout (Medium)	$27,500	Each	2.20	$61,000	Includes paving and signage (signs, posts, and foundations) - approximately 22,500 sf	0.97	Assumed - similar to Install Other General Warning Signs; CMF applied to crashes within 0.25 miles after sign
Formalize Pullout (Large)	$80,500	Each	2.20	$177,100	Includes paving and signage (signs, posts, and foundations) - approximately 70,000 sf	0.97	Assumed - similar to Install Other General Warning Signs; CMF applied to crashes within 0.25 miles after sign
INTERSECTION IMPROVEMENTS							
Construct Traffic Signal	$150,000	Each	2.20	$330,000	4-legged intersection; includes poles, foundations, conduit, controller, heads, luminaires, mast arms, etc.	0.95	From HSM; CMF applied to crashes within intersection only
Improve Signal Visibility	$35,000	Each	2.20	$77,000	4-legged intersection; signal head size upgrade, installation of new back-plates, and installation of additional signal heads on new poles.	0.85	Average of 7 values from clearinghouse; CMF applied to crashes within intersection only

SOLUTION	CONSTRUCTION UNIT COST	UNIT	FACTOR^	FACTORED CONSTRUCTION UNIT COST	DESCRIPTION	CMF FOR CORRIDOR PROFILE STUDIES	CMF NOTES
Install Raised Median	$360,000	Mile	2.20	$792,000	Includes removal of 14' wide pavement and construction of curb & gutter; does not include cost to widen roadway to accommodate the median; if the roadway needs to be widened, include cost from New General Purpose Lane	0.83	Average from HSM
Install Transverse Rumble Strip/Pavement Markings	$3,000	Each	2.20	$7,000	Includes pedestrian markings and rumble strips only across a 30' wide travelway; no pavement rehab or other striping	0.95	Average of 17 values from clearinghouse; CMF applied to crashes within 0.5 miles after the rumble strips and markings
Construct Single-Lane Roundabout	$1,500,000	Each	2.20	$3,300,000	Removal of signal at 4-legged intersection; realignment of each leg for approx. 800 feet including paving, curbs, sidewalk, striping, lighting, signing	0.22	From HSM; CMF applied to crashes within intersection only
Construct Double-Lane Roundabout	$1,800,000	Each	2.20	$3,960,000	Removal of signal at 4-legged intersection; realignment of each leg for approx. 800 feet including paving, curbs, sidewalk, striping, lighting, signing	0.40	From HSM; CMF applied to crashes within intersection only
ROADWAY DELINEATION							
Install High-Visibility Edge Line Striping	$10,800	Mile	2.20	$23,800	2 edge lines and lane line - one direction of travel	0.77	Average of 3 values from clearinghouse. Assumes package of striping, delineators, and RPMs. (If implemented separately, CMF will be higher.)
Install High-Visibility Delineators	$6,500	Mile	2.20	$14,300	Both edges - one direction of travel		Average of 3 values from clearinghouse. Assumes package of striping, delineators, and RPMs. (If implemented separately, CMF will be higher.)
Install Raised Pavement Markers	$2,000	Mile	2.20	$4,400	Both edges - one direction of travel		Average of 3 values from clearinghouse. Assumes package of striping, delineators, and RPMs. (If implemented separately, CMF will be higher.)
Install In-Lane Route Markings	$6,000	Each	2.20	$13,200	Installation of a series of three in-lane route markings in one lane	0.95	Assumed; CMF applied to crashes within 1.0 mile before the gore

SOLUTION	CONSTRUCTION UNIT COST	UNIT	FACTOR^	FACTORED CONSTRUCTION UNIT COST	DESCRIPTION	CMF FOR CORRIDOR PROFILE STUDIES	CMF NOTES
IMPROVED VISIBILITY							
Cut Side Slopes	$80	LF	2.20	$200	For small grading to correct sight distance issues; not major grading	0.85	Intent of this solution is to improve sight distance. Most CMF's are associated with vehicles traveling on slope. Recommended CMF is based on FDOT and NCDOT but is more conservative.
Install Lighting (connect to existing power)	$270,000	Mile	2.20	$594,000	One side of road only; offset lighting, not high-mast; does not include power supply; includes poles, luminaire, pull boxes, conduit, conductor	0.75 (night)	Average of 3 values on clearinghouse & consistent with HSM
Install Lighting (solar powered LED)	$10,000	Pole	2.20	$22,000	Offset lighting, not high-mast; solar power LED; includes poles, luminaire, solar panel	0.75 (night)	Average of 3 values on clearinghouse & consistent with HSM
DRIVER INFORMATION/WARNING							
Install Dynamic Message Sign (DMS)	$250,000	Each	2.20	$550,000	Includes sign, overhead structure, and foundations; wireless communication; does not include power supply	1.00	Not expected to reduce crashes
Install Dynamic Weather Warning Beacons	$40,000	Each	2.20	$88,000	Assumes solar operation and wireless communication or connection to existing power and communication; ground mounted; includes posts, foundations, solar panel, and dynamic sign	0.80 (weather related)	Average of 3 values from FHWA Desktop Reference for Crash Reduction Factors; CMF applies to crashes within 0.25 miles after a sign
Install Dynamic Speed Feedback Signs	$25,000	Each	2.20	$55,000	Assumes solar operation and no communication; ground mounted; includes regulatory sign, posts, foundations, solar panel, and dynamic sign	0.94	Average of 2 clearinghouse values; CMF applies to crashes within 0.50 miles after a sign
Install Chevrons	$18,400	Mile	2.20	$40,500	On one side of road - includes signs, posts, and foundations	0.79	Average of 11 clearinghouse values
Install Curve Warning Signs	$2,500	Each	2.20	$5,500	Includes 2 signs, posts, and foundations	0.83	Average of 4 clearinghouse values; CMF applies to crashes within 0.25 miles after a sign
Install Traffic Control Device Warning Signs (e.g., stop sign ahead, signal ahead, etc.)	$2,500	Each	2.20	$5,500	Includes 2 signs, posts, and foundations	0.85	FHWA Desktop Reference for Crash Reduction Factors; CMF applies to crashes within 0.25 miles after a sign
Install Other General Warning Signs (e.g., intersection ahead, wildlife in area, slow vehicles, etc.)	$2,500	Each	2.20	$5,500	Includes 2 signs, posts, and foundations	0.97	Assumed; CMF applies to crashes within 0.25 miles after a sign

SOLUTION	CONSTRUCTION UNIT COST	UNIT	FACTOR^	FACTORED CONSTRUCTION UNIT COST	DESCRIPTION	CMF FOR CORRIDOR PROFILE STUDIES	CMF NOTES
Install Wildlife Warning System	$162,000	Each	2.20	$356,400	Includes wildlife detection system at a designated wildlife crossing, flashing warning signs (assumes solar power), advance signing, CCTV (solar and wireless), game fencing for approximately 0.25 miles in each direction - centered on the wildlife crossing, and regular fencing for 1.0 mile in each direction - centered on the wildlife crossing.	0.50 (wildlife)	Assumed; CMF applies to wildlife-related crashes within 0.5 miles both upstream and downstream of the wildlife crossing in both directions
Install Warning Sign with Beacons	$15,000	Each	2.20	$33,000	In both directions; includes warning sign, post, and foundation, and flashing beacons (assumes solar power) at one location	0.75	FHWA Desktop Reference for Crash Reduction Factors for Installing Flashing Beacons as Advance Warning; CMF applies to crashes within 0.25 miles after a sign
Install Larger Stop Sign with Beacons	$10,000	Each	2.20	$22,000	In one direction; includes large stop sign, post, and foundation, and flashing beacons (assumes solar power) at one location	0.85/0.81	Use 0.85 for adding beacons to an existing sign; 0.81 for installing a larger sign with flashing beacons; CMF applies to intersection related crashes
DATA COLLECTION							
Install Roadside Weather Information System (RWIS)	$60,000	Each	2.20	$132,000	Assumes wireless communication and solar power, or connection to existing power and communications	1.00	Not expected to reduce crashes
Install Closed Circuit Television (CCTV) Camera	$25,000	Each	2.20	$55,000	Assumes connection to existing ITS backbone or wireless communication; does not include fiber-optic backbone infrastructure; includes pole, camera, etc.	1.00	Not expected to reduce crashes
Install Vehicle Detection Stations	$15,000	Each	2.20	$33,000	Assumes wireless communication and solar power, or connection to existing power and communications	1.00	Not expected to reduce crashes
Install Flood Sensors (Activation)	$15,000	Each	2.20	$33,000	Sensors with activation cabinet to alert through texting (agency)	1.00	Not expected to reduce crashes
Install Flood Sensors (Gates)	$100,000	Each	2.20	$220,000	Sensors with activation cabinet to alert through texting (agency) and beacons (public) plus gates	1.00	Not expected to reduce crashes
WIDEN CORRIDOR							
Construct New General Purpose Lane (PCCP)	$1,740,000	Mile	2.20	$3,830,000	For addition of 1 GP lane (PCCP) in one direction; includes all costs except bridges; for generally at-grade facility with minimal walls and no major drainage improvements	0.90	North Carolina DOT uses 0.90 and Florida DOT uses 0.87

SOLUTION	CONSTRUCTION UNIT COST	UNIT	FACTOR^	FACTORED CONSTRUCTION UNIT COST	DESCRIPTION	CMF FOR CORRIDOR PROFILE STUDIES	CMF NOTES
Construct New General Purpose Lane (AC)	$1,200,000	Mile	2.20	$2,640,000	For addition of 1 GP lane (AC) in one direction; includes all costs except bridges; for generally at-grade facility with minimal walls and no major drainage improvements	0.90	North Carolina DOT uses 0.90 and Florida DOT uses 0.88
Convert a 2-Lane undivided highway to a 5-Lane highway	$1,576,000	Mile	2.20	$3,467,200	For expanding a 2-lane undivided highway to a 5-lane highway (4 through lanes with TWLTL), includes standard shoulder widths but no curb, gutter, or sidewalks	0.60	Assumed to be slightly lower than converting from a 4-lane to a 5-lane highway
Install Center Turn Lane	$1,053,000	Mile	2.20	$2,316,600	For adding a center turn lane (i.e., TWLTL); assumes symmetrical widening on both sides of the road; includes standard shoulder widths but no curb, gutter, or sidewalk	0.75	From FHWA Desktop Reference for Crash Reduction Factors, CMF Clearinghouse, and SR 87 CPS comparison
Construct 4-Lane Divided Highway (Using Existing 2-Lane Road for one direction)	$3,000,000	Mile	2.20	$6,600,000	In both directions; one direction uses existing 2-lane road; other direction assumes addition of 2 new lanes (AC) with standard shoulders; includes all costs except bridges	0.67	Assumed
Construct 4-Lane Divided Highway (No Use of Existing Roads)	$6,000,000	Mile	2.20	$13,200,000	In both directions; assumes addition of 2 new lanes (AC) with standard shoulders in each direction; includes all costs except bridges	0.67	Assumed
Construct Bridge over At-Grade Railroad Crossing	$10,000,000	Each	2.20	$22,000,000	Assumes bridge width of 4 lanes (AC) with standard shoulders; includes abutments and bridge approaches; assumes vertical clearance of 23'4" + 6'8" superstructure	0.72 (All train-related crashes eliminated)	Removes all train-related crashes at at-grade crossing; all other crashes CMF = 0.72
Construct Underpass at At-Grade Railroad Crossing	$15,000,000	Each	2.20	$33,000,000	Assumes underpass width of 4 lanes (AC) with standard shoulders; includes railroad bridge with abutments and underpass approaches; assumes vertical clearance of 16'6" + 6'6" superstructure	0.72 (All train-related crashes eliminated)	Removes all train-related crashes at at-grade crossing; all other crashes CMF = 0.72
Construct High-Occupancy Vehicle (HOV) Lane	$900,000	Mile	2.20	$1,980,000	For addition of 1 HOV lane (AC) in one direction with associated signage and markings; includes all costs except bridges; for generally at-grade facility with minimal walls and no major drainage improvements	0.95	Similar to general purpose lane

SOLUTION	CONSTRUCTION UNIT COST	UNIT	FACTOR^	FACTORED CONSTRUCTION UNIT COST	DESCRIPTION	CMF FOR CORRIDOR PROFILE STUDIES	CMF NOTES
ALTERNATE ROUTE							
Construct Frontage Roads	$2,400,000	Mile	2.20	$5,280,000	For 2-lane AC frontage road; includes all costs except bridges; for generally at-grade facility with minimal walls	0.90	Assumed - similar to new general purpose lane
Construct 2-Lane Undivided Highway	$3,000,000	Mile	2.20	$6,600,000	In both directions; assumes addition of 2 new lanes (AC) with standard shoulders in each direction; includes all costs except bridges	0.90	Assuming new alignment for a bypass
OTHER IMPROVEMENTS							
Install Curb and Gutter	$211,200	Mile	2.20	$465,000	In both directions; curb and gutter	0.89	From CMF Clearinghouse
Install Sidewalks, Curb, and Gutter	$475,200	Mile	2.20	$1,045,000	In both directions; 5' sidewalks, curb, and gutter	0.89 installing sidewalk 0.24 (pedestrian crashes only)	From CMF Clearinghouse Average of 6 values from FHWA Desktop Reference
Install Sidewalks	$264,000	Mile	2.20	$581,000	In both directions; 5' sidewalks	0.24 (pedestrian crashes only)	Average of 6 values from FHWA Desktop Reference
Install Advanced Warning Signal System	$108,000	each	2.20	$238,000	Overhead static sign with flashing beacons, detectors, and radar system. Signs for each mainline approach of the intersection (2)	0.61	FHWA Desktop Reference for CRF
Install Indirect Left Turn Intersection	$1,140,000	each	2.20	$2,500,000	Raised concrete median improvements; intersection improvements; turn lanes	0.80	CMF Clearinghouse
Convert Standard Diamond Interchange to Diverging Diamond Interchange	$2,272,700	each	2.20	$5,000,000	Convert traditional diamond interchange into diverging diamond interchange; assumes re-use of existing bridges	0.67	CMF Clearinghouse
Install Adaptive Signal Control and Signal Coordination	$363,500	mile	2.20	$800,000	Controller upgrades, advanced detection, software configuration, cameras; includes conduit, conductors, and controllers for 4 intersections that span a total of approximately 2 miles for coordination	0.81 (adaptive control) 0.90 (signal coordination)	CMF Clearinghouse
Left-in Only Center Raised Median Improvements	$84,100	each	2.20	$185,000	Left-in only center raised median improvements	0.87	CMF Clearinghouse

^ Factor accounts for traffic control, erosion control, construction surveying and quality control, mobilization, construction engineering, contingencies, indirect cost allocation, and miscellaneous work

Appendix G: Performance Area Risk Factors

Pavement Performance Area

- Elevation
- Mainline Daily Traffic Volume
- Mainline Daily Truck Volume

Elevation

Variance above 4000' divided by 1000; (Elev-4000)/1000

Score	Condition
0	< 4000’
0-5	4000’- 9000’
5	> 9000’

Mainline Daily Traffic Volume

Exponential equation; score = $5-(5*e^{(ADT*-0.000039)})$

Score	Condition
0	< 6,000
0-5	6,000 – 160,000
5	>160,000

Mainline Daily Truck Volume

Exponential equation; score = $5-(5*e^{(ADT*-0.00025)})$

Score	Condition
0	<900
0-5	900-25,000
5	>25,000

Bridge Performance Area

- Mainline Daily Traffic Volume
- Elevation
- Carries Mainline Traffic
- Detour Length
- Scour Critical Rating
- Vertical Clearance

Mainline Daily Traffic Volume

Exponential equation; score = $5-(5*e^{(ADT*-0.000039)})$

Score	Condition
0	<6,000
0-5	6,000-160,000
5	>160,000

Elevation

Variance above 4000' divided by 1000; (Elev-4000)/1000

Score	Condition
0	< 4000’
0-5	4000’- 9000’
5	> 9000’

Carries Mainline Traffic

Score	Condition
0	Does not carry mainline traffic
5	Carries mainline traffic

Detour Length

Divides detour length by 10 and multiplies by 2.5

Score	Condition
0	0 miles
0-5	0-20 miles
5	> 20 miles

Scour Critical Rating

Variance below 8

Score	Condition
0	Rating > 8
0-5	Rating 8 - 3
5	Rating < 3

Vertical Clearance

Variance below 16’ x 2.5; (16 –Clearance) x 2.5

Score	Condition
0	>16’
0-5	16’-14’
5	<14’

Mobility Performance Area

- Mainline VMT
- Buffer Index (PTI-TTI)
- Detour Length
- Outside Shoulder Width

Mainline VMT

Exponential equation; score = 5-(5*e(ADT*-0.0000139))

Score	Condition
0	<16,000
0-5	16,000-400,000
5	>400,000

Buffer Index

Buffer Index x 10

Score	Condition
0	Buffer Index = 0.00
0-5	Buffer Index 0.00-0.50
5	Buffer Index > 0.50

Detour Length

Score	Condition
0	Detour < 10 miles
5	Detour > 10 miles

Outside Shoulder Width

Variance below 10', if only 1 lane in each direction

Score	Condition
0	10' or above or >1 lane in each direction
0-5	10'-5' and 1 lane in each direction
5	5' or less and 1 lane in each direction

Safety Performance Area

- Mainline Daily Traffic Volume
- Interrupted Flow
- Elevation
- Outside Shoulder Width
- Vertical Grade

Mainline Daily Traffic Volume

Exponential equation; score = 5-(5*$e^{(ADT*-0.000039)}$)

Score	Condition
0	<6,000
0-5	6,000-160,000
5	>160,000

Interrupted Flow

Score	Condition
0	Not interrupted flow
5	Interrupted Flow

Elevation

Variance above 4000' divided by 1000; (Elev-4000)/1000

Score	Condition
0	< 4000'
0-5	4000'- 9000'
5	> 9000'

Outside Shoulder Width

Variance below 10'

Score	Condition
0	10' or above
0-5	10' - 5'
5	5' or less

Grade

Variance above 3% x 1.5

Score	Condition
0	< 3%
0-5	3% - 6.33%
5	>6.33%

Freight Performance Area

- Mainline Daily Truck Volume
- Detour Length
- Truck Buffer Index (TPTI-TTTI)
- Outside Shoulder Width

Mainline Daily Truck Volume

Exponential equation; score = 5-(5*$e^{(ADT*-0.00025)}$)

Score	Condition
0	<900
0-5	900-25,000
5	>25,000

Detour Length

Score	Condition
0	Detour < 10 miles
5	Detour > 10 miles

Truck Buffer Index

Truck Buffer Index x 10

Score	Condition
0	Buffer Index = 0.00
0-5	Buffer Index 0.00-0.50
5	Buffer Index > 0.50

Outside Shoulder Width

Variance below 10', if only 1 lane in each direction

Score	Condition
0	10' or above or >1 lane in each direction
0-5	10'-5' and 1 lane in each direction
5	5' or less and 1 lane in each direction

Solution Number	Mainline Traffic Vol (vpd) (2-way)	Solution Length (miles)	Bridge Detour Length (miles) (N19)	Elevation (ft)	Scour Critical Rating (0-9)	Carries Mainline Traffic (Y/N)	Bridge Vert. Clear (ft)	Mainline Truck Vol (vpd) (2-way)	Detour Length > 10 miles (Y/N)	Truck Buffer Index	Non-Truck Buffer Index	Grade (%)	Interrupted Flow (Y/N)	Outside/ Right Shoulder Width (ft)	1-lane each direction
CS95N.1 (Options A and B)	12,256	1.20		470				1,955	Y	0.82	0.69	0.5	Y	3.32	N
CS95N.2	22,671	3.90		550				2,910	N	2.84	2.12	0.8	Y	1.60	N
CS95N.3	27,747	8.50		550				1,751	N	5.58	5.50	1.3	Y	0.02	N
CS68.4	9,351	5.70		1,300				1,341	Y	2.40	1.53	4.5	Y	8.91	N
CS68.5 (Options A and B)	7,782	2.50		3,000				1,541	Y	1.10	0.50	5.8	N	9.48	N
CS68.6	9,028	5.20		2,800				1,948	N	0.56	0.30	0.5	N	9.46	N
CS68.7	11,468	4.80		2,900				2,317	Y	0.35	0.25	1.9	N	9.89	N

Solution Number	Bridge	Pavement	Mobility	Safety	Freight	Risk Score (0 to 10)				
						Bridge	Pavement	Mobility	Safety	Freight
CS95N.1 (Options A and B)	N	Y	Y	Y	Y	0.00	2.55	3.23	4.75	3.79
CS95N.2	N	N	Y	Y	Y	0.00	0.00	2.58	5.17	2.39
CS95N.3	N	N	Y	Y	Y	0.00	0.00	4.52	5.32	3.04
CS68.4	N	N	Y	Y	Y	0.00	0.00	4.40	3.94	4.14
CS68.5 (Options A and B)	N	N	Y	Y	Y	0.00	0.00	5.59	2.41	5.80
CS68.6	N	N	Y	Y	Y	0.00	0.00	2.67	0.80	3.47
CS68.7	N	N	Y	Y	Y	0.00	0.00	5.07	0.76	5.34

Appendix H: Candidate Solution Cost Estimates

Candidate Solution #	Candidate Solution Name	Scope	BMP	EMP	Unit	Quantity	Factored Construction Unit Cost	Preliminary Engineering Cost	Design Cost	Right-of-Way Cost	Construction Cost	Total Cost	Notes
CS95N.1A	Arizona Village Area Safety and Mobility Improvements	Convert 2-Lane undivided highway to 4-Lane divided highway with raised median (including pavement removal, new pavement, curb and gutter, median curb, and sidewalks)	226.1	227.3	mi	1.2	$4,369,200	$157,000	$524,000	$0	$5,243,040	$5,924,040	Does not include widening the Colorado River Bridge
							Solution Total	**$157,000**	**$524,000**	**$0**	**$5,243,040**	**$5,924,000**	
CS95N.1B	Arizona Village Area Safety and Mobility Improvements	Construct raised median	226.1	227.3	mi	1.2	$792,000	$29,000	$95,000	$0	$950,400	$1,074,000	Does not include widening the Colorado River Bridge
							Solution Total	**$29,000**	**$95,000**	**$0**	**$950,400**	**$1,074,000**	
CS95N.2	Fort Mojave Area Safety and Mobility Improvements	Implement signal coordination, Boundary Cone Road to Bullhead Parkway South	234.4	240.7	each	6.3	$954,000	$29,000	$95,000	$0	$954,000	$1,078,000	Factored Construction Unit Cost altered to reflect a total of 9 signals over 6.3 miles
		Improve signal visibility, Boundary Cone Road	234.4		each	1	$77,000	$2,000	$8,000	$0	$77,000	$87,000	
		Improve signal visibility, El Rodeo Drive	237.4		each	1	$77,000	$2,000	$8,000	$0	$77,000	$87,000	
		Construct raised median, various locations between Lipan Blvd and Teller Lane	235	237.1	mi	1.8	$792,000	$43,000	$143,000	$0	$1,425,600	$1,611,600	
		Construct sidewalks, various locations between Lipan Blvd and Teller Lane	235	237.1	mi	0.4	$581,000	$7,000	$23,000	$0	$232,400	$262,400	
		Construct curb, gutter, and sidewalks, Lipan Blvd to Teller Lane	235	237.1	mi	1.7	$1,045,000	$53,000	$178,000	$0	$1,776,500	$2,007,500	
		Install lighting, South of Lipan Blvd to El Rodeo Drive	235	237.4	mi	2.4	$594,000	$43,000	$143,000	$0	$1,425,600	$1,611,600	
		Install lighting, Valencia Road to Sterling Road	238.9	239.5	mi	0.6	$594,000	$11,000	$36,000	$0	$356,400	$403,400	
		Construct traffic signal, Chaparral Road	236.2		each	1	$330,000	$10,000	$33,000	$0	$330,000	$373,000	
		Construct traffic signal, Corwin Road	239.9		each	1	$330,000	$10,000	$33,000	$0	$330,000	$373,000	
		Construct raised median, Valencia Road to Bullhead Parkway South	238.9	241	mi	2.1	$792,000	$50,000	$166,000	$0	$1,663,200	$1,879,200	
		Construct sidewalks, various locations between Valencia Road and Bullhead Parkway South	238.9	241	mi	0.85	$581,000	$15,000	$49,000	$0	$493,850	$557,850	
		Construct curb, gutter, and sidewalks, various locations between Valencia Road and Bullhead Parkway South	238.9	241	mi	0.5	$1,045,000	$16,000	$52,000	$0	$522,500	$590,500	
							Solution Total	**$291,000**	**$967,000**	**$0**	**$9,664,050**	**$10,922,000**	

Candidate Solution #	Candidate Solution Name	Scope	BMP	EMP	Unit	Quantity	Factored Construction Unit Cost	Preliminary Engineering Cost	Design Cost	Right-of-Way Cost	Construction Cost	Total Cost	Notes
CS95N.3	Bullhead City Safety, Mobility, and Freight Improvements	Install raised median, Bullhead Parkway South to Aviation Way	241	249.5	mi	8.5	$792,000	$202,000	$673,000	$0	$6,732,000	$7,607,000	
		Implement signal coordination, Mohave Community College access to Bullhead Parkway North	241.1	249.8	each	8.5	$1,351,460	$41,000	$135,000	$0	$1,351,460	$1,527,460	Factored Construction Unit Cost altered to reflect a total of 18 signals over 8.5 miles
		Improve signal visibility, Mohave Drive	242.8		each	1	$77,000	$2,000	$8,000	$0	$77,000	$87,000	
		Improve signal visibility, Ramar Road	244.9		each	1	$77,000	$2,000	$8,000	$0	$77,000	$87,000	
		Construct SB right turn lane, Marina Blvd	243.9		each	1	$93,500	$3,000	$9,000	$0	$93,500	$105,500	
		Construct SB right turn lane, Thunderstruck Drive	244.2		each	1	$93,500	$3,000	$9,000	$0	$93,500	$105,500	
		Implement protected left-turn phasing, Hancock Road	244.3		each	1	$16,500	$0	$2,000	$0	$16,500	$18,500	
		Install sidewalk on the west side of SR 95	see Notes column		mi	1.3	$581,000	$23,000	$76,000	$0	$755,300	$854,300	Fills in the only missing links of sidewalk for the segment, MP 241.0-241.7 and MP 242.2-242.8
		Solution Total						**$276,000**	**$920,000**	**$0**	**$9,196,260**	**$10,392,260**	

Candidate Solution #	Candidate Solution Name	Scope	BMP	EMP	Unit	Quantity	Factored Construction Unit Cost	Preliminary Engineering Cost	Design Cost	Right-of-Way Cost	Construction Cost	Total Cost	Notes
CS68.4	Sunridge Area Safety Improvements	Rehabilitate shoulder, EB	1.3	7.0	mi	5.7	$249,000	$43,000	$142,000	$0	$1,419,300	$1,604,300	
		Rehabilitate shoulder, WB	1.3	7.0	mi	5.7	$249,000	$43,000	$142,000	$0	$1,419,300	$1,604,300	
		Increase delineation, EB	0.0	1.3	mi	1.3	$42,500	$2,000	$6,000	$0	$55,250	$63,250	
		Install high-visibility edge line striping	-	-	-	-	$23,800	-	-	-	-	-	
		Install high-visibility delineators	-	-	-	-	$14,300	-	-	-	-	-	
		Install recessed pavement markers	-	-	-	-	$4,400	-	-	-	-	-	
		Increase delineation, WB	0.0	1.3	mi	1.3	$42,500	$2,000	$6,000	$0	$55,250	$63,250	
		Install high-visibility edge line striping	-	-	-	-	$23,800	-	-	-	-	-	
		Install high-visibility delineators	-	-	-	-	$14,300	-	-	-	-	-	
		Install recessed pavement markers	-	-	-	-	$4,400	-	-	-	-	-	
		Construct raised median	2.1	2.6	mi	0.5	$792,000	$12,000	$40,000	$0	$396,000	$448,000	
		Install lighting, EB	2.1	3.0	mi	0.9	$594,000	$16,000	$53,000	$0	$534,600	$603,600	
		Install lighting, WB	2.1	3.0	mi	0.9	$594,000	$16,000	$53,000	$0	$534,600	$603,600	
		Install chevrons, EB	0.6 4.1 6.5	0.9 4.6 6.9	mi	1.2	$40,500	$1,000	$5,000	$0	$48,600	$54,600	
		Install chevrons, WB	0.6 4.1 6.5	0.9 4.6 6.9	mi	1.2	$40,500	$1,000	$5,000	$0	$48,600	$54,600	
		Install curve warning signs	0.6 4.1 6.5	0.9 4.6 6.9	each	3	$5,500	$500	$2,000	$0	$16,500	$19,000	unit cost assumes 2 signs, results in one sign each direction at each curve
							Solution Total	**$136,500**	**$454,000**	**$0**	**$4,528,000**	**$5,118,500**	

Candidate Solution #	Candidate Solution Name	Scope	BMP	EMP	Unit	Quantity	Factored Construction Unit Cost	Preliminary Engineering Cost	Design Cost	Right-of-Way Cost	Construction Cost	Total Cost	Notes
CS68.5A	Black Mountains Area Safety and Freight Improvements	Install cable median barrier	8.6	11.1	mi	2.5	$176,000	$13,000	$44,000	$0	$440,000	$497,000	
		Rehabilitate shoulder, EB	7.0	17.0	mi	10	$249,000	$75,000	$249,000	$0	$2,490,000	$2,814,000	
		Rehabilitate shoulder, WB	7.0	17.0	mi	7	$249,000	$52,000	$174,000	$0	$1,743,000	$1,969,000	
		Install chevrons, EB	8.6	9.1	mi	0.5	$40,500	$1,000	$2,000	$0	$20,250	$23,250	
		Install chevrons, WB	8.6	9.1	mi	0.5	$40,500	$1,000	$2,000	$0	$20,250	$23,250	
		Install chevrons, EB	10.6	11.1	mi	0.5	$40,500	$1,000	$2,000	$0	$20,250	$23,250	
		Install chevrons, WB	10.6	11.1	mi	0.5	$40,500	$1,000	$2,000	$0	$20,250	$23,250	
		Install curve warning signs with flashing beacons	8.9		each	1	$33,000	$1,000	$3,000	$0	$33,000	$37,000	unit cost assumes 1 sign for each direction
		Install curve warning signs with flashing beacons	10.9		each	1	$33,000	$1,000	$3,000	$0	$33,000	$37,000	unit cost assumes 1 sign for each direction
		Install speed feedback signs, EB	8.6		each	1	$55,000	$2,000	$6,000	$0	$55,000	$63,000	
		Install speed feedback signs, WB	11.1		each	1	$55,000	$2,000	$6,000	$0	$55,000	$63,000	
							Solution Total	**$150,000**	**$493,000**	**$0**	**$4,930,000**	**$5,573,000**	
CS68.5B	Black Mountains Area Safety and Freight Improvements	Install raised concrete barrier in median	8.6	11.1	mi	2.5	$1,430,000	$107,000	$358,000	$0	$3,575,000	$4,040,000	
		Rehabilitate shoulder, EB	7.0	17.0	mi	10	$249,000	$75,000	$249,000	$0	$2,490,000	$2,814,000	
		Rehabilitate shoulder, WB	7.0	17.0	mi	7	$249,000	$52,000	$174,000	$0	$1,743,000	$1,969,000	
		Install chevrons, EB	8.6	9.1	mi	0.5	$40,500	$1,000	$2,000	$0	$20,250	$23,250	
		Install chevrons, WB	8.6	9.1	mi	0.5	$40,500	$1,000	$2,000	$0	$20,250	$23,250	
		Install chevrons, EB	10.6	11.1	mi	0.5	$40,500	$1,000	$2,000	$0	$20,250	$23,250	
		Install chevrons, WB	10.6	11.1	mi	0.5	$40,500	$1,000	$2,000	$0	$20,250	$23,250	
		Install curve warning signs with flashing beacons	8.9		each	1	$33,000	$1,000	$3,000	$0	$33,000	$37,000	unit cost assumes 1 sign for each direction
		Install curve warning signs with flashing beacons	10.9		each	1	$33,000	$1,000	$3,000	$0	$33,000	$37,000	unit cost assumes 1 sign for each direction
		Install speed feedback signs, EB	8.6		each	1	$55,000	$2,000	$6,000	$0	$55,000	$63,000	
		Install speed feedback signs, WB	11.1		each	1	$55,000	$2,000	$6,000	$0	$55,000	$63,000	
							Solution Total	**$244,000**	**$807,000**	**$0**	**$8,065,000**	**$9,116,000**	

Candidate Solution #	Candidate Solution Name	Scope	BMP	EMP	Unit	Quantity	Factored Construction Unit Cost	Preliminary Engineering Cost	Design Cost	Right-of-Way Cost	Construction Cost	Total Cost	Notes
CS68.6	West Golden Valley Area Safety and Freight Improvements	Construct indirect left-turn improvements at Egar Road	16.8		each	1.0	$2,500,000	$75,000	$250,000	$100,000	$2,500,000	$2,925,000	
		Construct indirect left-turn improvements at Estrella Road	17.8		each	1.0	$2,500,000	$75,000	$250,000	$100,000	$2,500,000	$2,925,000	
		Install raised median	16.8	17.8	mi	1.0	$1,675,000	$50,000	$168,000	$0	$1,675,000	$1,893,000	Between indirect left turns
		Construct left-in only raised median improvements at Milky Way Road	18.7		each	1.0	$185,000	$6,000	$19,000	$0	$185,000	$210,000	
		Construct indirect left-turn improvements at Teddy Roosevelt Road	19.8		each	1.0	$2,500,000	$75,000	$250,000	$100,000	$2,500,000	$2,925,000	
		Construct double-lane roundabout at Colorado Road	20.8		each	1.0	$2,350,000	$71,000	$235,000	$250,000	$2,350,000	$2,906,000	
		Construct double-lane roundabout at Verde Road	21.8		each	1.0	$2,350,000	$71,000	$235,000	$250,000	$2,350,000	$2,906,000	
		Install center raised median	20.8	22.0	mi	1.2	$1,675,000	$60,000	$201,000	$0	$2,010,000	$2,271,000	Between roundabouts and the 0.2 miles after Verde Road (MP 21.8-22.0)
		Install lighting at 6 major intersections: Egar Rd, Estrella Rd, Milky Way Rd, Teddy Roosevelt Rd, Colorado Rd, and Verde Rd.	16.8	22.0	mi	1.8	$594,000	$32,000	$108,000	$0	$1,080,000	$1,220,000	3 lights (400 ft.) per approach for each intersection (total of 6 intersections) = 9600 ft (1.82 miles)
							Solution Total	**$515,000**	**$1,716,000**	**$800,000**	**$17,150,000**	**$20,181,000**	
CS68.7	East Golden Valley Area Safety Improvements	Install lighting (Adobe Rd intersection, MP 23.7-24.9, and MP 25.3-26.7)	22.8	26.7	mi	2.9	$594,000	$52,000	$172,000	$0	$1,724,400	$1,948,400	Adobe Rd intersection (3 lights (or 400 ft.) per approach = 1600 ft., MP 23.7-24.9 and MP 25.3-26.7)
		Install center median, Verde Road to Kofa Road	22.0	26.8	mi	4.8	$1,675,000	$241,000	$804,000	$0	$8,040,000	$9,085,000	
		Construct double-lane roundabout at Adobe Road	22.8		each	1.0	$2,350,000	$71,000	$235,000	$250,000	$2,350,000	$2,906,000	
		Construct double-lane roundabout at Aztec Road	23.8		each	1.0	$2,350,000	$71,000	$235,000	$250,000	$2,350,000	$2,906,000	
		Construct double-lane roundabout at Bacobi Road	24.8		each	1.0	$2,350,000	$71,000	$235,000	$250,000	$2,350,000	$2,906,000	
							Solution Total	**$506,000**	**$1,681,000**	**$750,000**	**$16,814,400**	**$19,751,400**	

Appendix I: Performance Effectiveness Scores

Need Reduction

		Solution #	CS95N.1 A	CS95N.1 B	CS95N.2	CS95N.3	CS68.4	CS68.5A	CS68.5B	CS68.6	CS68.7
		Description	Arizona Village Area Safety and Mobility Improvements - Opiton A	Arizona Village Area Safety and Mobility Improvements - Option B	Fort Mohave Area Safety and Mobility Improvements	Bullhead City Area Safety, Mobility, and Freight Improvements	Sunridge Area Safety Improvements	Black Mountains Area Safety and Freight Improvements	Black Mountains Area Safety and Freight Improvements	West Golden Valley Area Safety and Freight Improvements	East Golden Valley Area Safety Improvements
		Project Beg MP	226.1	226.1	233	241	0	7	7	17	22
		Project End MP	227.3	227.3	241	249.8	7	17	17	22	27
		Project Length (miles)	1.2	1.2	3.90	8.50	5.7	2.5	2.5	5.20	4.80
		Segment Beg MP	226	226	233	241	0	7	7	17	22
		Segment End MP	233	233	241	250	7	17	17	22	27
		Segment Length (miles)	7	7	8	9	7	10	10	5	5
		Segment #	95N-1	95N-1	95N-2	95N-3	68-4	68-5	68-5	68-6	68.7
		Current # of Lanes (both directions)	2	2	4	4	4	4	4	4	4
		Project Type (one-way or two-way)	two-way	two-way	two-way	two-way	two-way	two-way	two-way	two-way	two-way
		Additional Lanes (one-way)	1	0	0	0	0	0	0	0	0
		Pro-Rated # of Lanes	2.34	2.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
		Description									
SAFETY	DIRECTIONAL SAFETY	Orig Segment Directional Safety Index (direction 1)	0.098	0.098	3.102	0.725	1.253	1.818	1.818	4.343	4.156
		Orig Segment Directional Fatal Crashes (direction 1)	0	0	5	1	1	2	2	3	4
		Orig Segment Directional Incap Crashes (direction 1)	2	2	26	14	4	6	6	3	6
		Original Fatal Crashes in project limits (direction 1)	0	0	5	1	1	2	2	3	4
		Original Incap Crashes in project limits (direction 1)	1	1	25	13	4	6	6	3	6
		CMF 1 (direction 1)(lowest CMF)	0.6	0.83	Total CMF calculated in separate worksheet	Total CMF calculated in separate worksheet	Total CMF calculated in separate worksheet	Total CMF calculated in separate worksheet	Total CMF calculated in separate worksheet	Total CMF calculated in separate worksheet	Total CMF calculated in separate worksheet
		CMF 2 (direction 1)	0.83	1							
		CMF 3 (direction 1)	1	1							
		CMF 4 (direction 1)	1	1							
		CMF 5 (direction 1)	1	1							
		Total CMF (direction 1)	0.549	0.830	-	-	-	-	-	-	-
		Fatal Crash reduction (direction 1)	0.000	0.000	0.957	0.212	0.424	0.869	1.406	0.570	0.824
		Incap Crash reduction (direction 1)	0.451	0.170	4.713	2.962	1.159	2.143	2.652	1.420	1.594
		Post-Project Segment Directional Fatal Crashes (direction 1)	0.000	0.000	4.043	0.788	0.576	1.131	0.594	2.430	3.176
		Post-Project Segment Directional Incap Crashes (direction 1)	1.549	1.830	21.287	11.038	2.841	3.857	3.348	1.580	4.406
		Post-Project Segment Directional Safety Index (direction 1)	0.076	0.090	2.516	0.572	0.758	1.052	0.621	3.438	3.276
		Post-Project Segment Directional Safety Index (direction 1)	0.076	0.090	2.516	0.572	0.758	1.052	0.621	3.438	3.276
		Orig Segment Directional Safety Index (direction 2)	1.053	1.053	1.658	3.715	0.974	3.746	3.746	1.798	4.082
		Orig Segment Directional Fatal Crashes (direction 2)	1	1	2	9	1	5	5	1	4
		Orig Segment Directional Incap Crashes (direction 2)	7	7	24	14	0	0	0	5	3
		Original Fatal Crashes in project limits (direction 2)	0	0	2	9	1	5	5	1	4
		Original Incap Crashes in project limits (direction 2)	3	3	24	14	0	0	0	4	3
		CMF 1 (direction 2)(lowest CMF)	0.6	0.83	Total CMF calculated in separate worksheet	Total CMF calculated in separate worksheet	Total CMF calculated in separate worksheet	Total CMF calculated in separate worksheet	Total CMF calculated in separate worksheet	Total CMF calculated in separate worksheet	Total CMF calculated in separate worksheet
		CMF 2 (direction 2)	0.83	1							
		CMF 3 (direction 2)	1	1							
		CMF 4 (direction 2)	1	1							
		CMF 5 (direction 2)	1	1							
		Total CMF (direction 2)	0.549	0.830	-	-	-	-	-	-	-
		Fatal Crash reduction (direction 2)	0.000	0.000	0.355	2.047	0.369	2.172	2.031	0.200	0.968
		Incap Crash reduction (direction 2)	1.353	0.510	4.426	3.115	0.000	0.000	0.000	0.860	0.940
		Post-Project Segment Directional Fatal Crashes (direction 2)	1.000	1.000	1.645	6.953	0.631	2.828	2.969	0.800	3.032
		Post-Project Segment Directional Incap Crashes (direction 2)	5.647	6.490	19.574	10.885	0.000	0.000	0.000	4.140	2.060
		Post-Project Segment Directional Safety Index (direction 2)	0.987	1.028	1.359	2.872	0.614	2.119	2.224	1.451	3.080
		Post-Project Segment Directional Safety Index (direction 2)	0.987	1.028	1.359	2.872	0.614	2.119	2.224	1.451	3.080
	SAFETY INDEX	Current Safety Index	0.575	0.575	2.380	2.220	1.113	2.782	2.782	3.070	4.119
		Post-Project Safety Index	0.531	0.559	1.937	1.722	0.686	1.586	1.423	2.445	3.178
	Needs	Original Segment Safety Need	0.959	0.959	7.507	6.879	2.935	8.851	8.851	9.950	14.142
		Post-Project Segment Safety Need	0.883	0.931	5.818	5.017	1.448	4.277	3.434	7.563	10.552

LEGEND:
-user entered value
-calculated value for reference
-calculated value for use in other spreadsheet
-for input into PES spreadsheet
-assumed values

Direction 1 = NB/EB
Direction 2 = SB/WB

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-user entered value
-calculated value for reference
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-for input into PES spreadsheet
-assumed values

Direction 1 = NB/EB
Direction 2 = SB/WB

		Solution #	CS95N.1 A	CS95N.1 B	CS95N.2	CS95N.3	CS68.4	CS68.5A	CS68.5B	CS68.6	CS68.7
		Description	Arizona Village Area Safety and Mobility Improvements - Opiton A	Arizona Village Area Safety and Mobility Improvements - Option B	Fort Mohave Area Safety and Mobility Improvements	Bullhead City Area Safety, Mobility, and Freight Improvements	Sunridge Area Safety Improvements	Black Mountains Area Safety and Freight Improvements	Black Mountains Area Safety and Freight Improvements	West Golden Valley Area Safety and Freight Improvements	East Golden Valley Area Safety Improvements
		Project Beg MP	226.1	226.1	233	241	0	7	7	17	22
		Project End MP	227.3	227.3	241	249.8	7	17	17	22	27
		Project Length (miles)	1.2	1.2	3.90	8.50	5.7	2.5	2.5	5.20	4.80
		Segment Beg MP	226	226	233	241	0	7	7	17	22
		Segment End MP	233	233	241	250	7	17	17	22	27
		Segment Length (miles)	7	7	8	9	7	10	10	5	5
		Segment #	95N-1	95N-1	95N-2	95N-3	68-4	68-5	68-5	68-6	68.7
		Current # of Lanes (both directions)	2	2	4	4	4	4	4	4	4
		Project Type (one-way or two-way)	two-way	two-way	two-way	two-way	two-way	two-way	two-way	two-way	two-way
		Additional Lanes (one-way)	1	0	0	0	0	0	0	0	0
		Pro-Rated # of Lanes	2.34	2.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
		Description									
MOBILITY	MOBILITY INDEX	Original Segment Mobility Index	0.650	0.650	0.890	1.320	0.400	0.200	0.200	0.140	0.180
		Post-Project # of Lanes (both directions)	2.34	2.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
		Post-Project Segment Mobility Index	0.59	0.65	0.810	1.14	0.400	0.200	0.200	0.14	0.18
		Post-Project Segment Mobility Index	0.590	0.650	0.810	1.140	0.400	0.200	0.200	0.140	0.180
	FUT V/C	Original Segment Future V/C	0.860	0.860	1.090	1.840	0.500	0.220	0.220	0.150	0.190
		Post-Project Segment Future V/C	0.780	0.860	0.990	1.590	0.500	0.220	0.220	0.150	0.190
		Post-Project Segment Future V/C	0.780	0.860	0.990	1.590	0.500	0.220	0.220	0.150	0.190
	PEAK HOUR V/C	Original Segment Peak Hour V/C (direction 1)	0.440	0.440	0.670	0.680	0.260	0.170	0.170	0.120	0.150
		Original Segment Peak Hour V/C (direction 2)	0.450	0.450	0.680	0.660	0.260	0.170	0.170	0.120	0.110
		Adjusted total # of Lanes for use in directional peak hr	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Post-Project Segement Peak Hr V/C (direction 1)	0.400	0.440	0.580	0.56	0.260	0.170	0.170	0.12	0.150
		Post-Project Segement Peak Hr V/C (direction 2)	0.410	0.450	0.590	0.55	0.260	0.170	0.170	0.12	0.110
		Post-Project Segment Peak Hr V/C (direction 1)	0.400	0.440	0.580	0.560	0.260	0.170	0.170	0.120	0.150
		Post-Project Segment Peak Hr V/C (direction 2)	0.410	0.450	0.590	0.550	0.260	0.170	0.170	0.120	0.110
	TTI AND PTI	Safety Reduction Factor	0.923	0.971	0.814	0.776	0.616	0.570	0.511	0.796	0.772
		Safety Reduction	0.077	0.029	0.186	0.224	0.384	0.430	0.489	0.204	0.228
		Mobility Reduction Factor	0.908	1.000	0.910	0.864	1.000	1.000	1.000	1.000	1.000
		Mobility Reduction	0.092	0.000	0.090	0.136	0.000	0.000	0.000	0.000	0.000
		Mobility effect on TTI	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
		Mobility effect on PTI	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
		Safety effect on TTI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Safety effect on PTI	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
		Original Directional Segment TTI (direction 1)	1.042	1.042	1.220	1.460	1.046	1.061	1.061	1.012	1.000
		Original Directional Segment PTI (direction 1)	1.890	1.890	3.431	8.265	1.942	1.707	1.707	1.345	1.288
		Original Directional Segment TTI (direction 2)	1.007	1.007	1.193	1.439	1.112	1.032	1.032	1.007	1.000
		Original Directional Segment PTI (direction 2)	1.536	1.536	3.217	5.635	3.276	1.393	1.393	1.265	1.207
		Reduction Factor for Segment TTI	0.028	0.000	0.027	0.041	0.000	0.000	0.000	0.000	0.000
		Reduction Factor for Segment PTI	0.041	0.009	0.074	0.095	0.115	0.129	0.147	0.061	0.069
		Post-Project Directional Segment TTI (direction 1)	1.013	1.042	1.187	1.400	1.046	1.061	1.061	1.012	1.000
		Post-Project Directional Segment PTI (direction 1)	1.812	1.874	3.178	7.483	1.719	1.486	1.456	1.262	1.200
		Post-Project Directional Segment TTTI (direction 2)	1.003	1.007	1.161	1.380	1.112	1.032	1.032	1.007	1.000
		Post-Project Directional Segment TPTI (direction 2)	1.473	1.523	2.980	5.102	2.899	1.213	1.189	1.188	1.124
	CLOSURE EXTENT	Orig Segment Directional Closure Extent (direction 1)	0.371	0.371	0.125	0.644	0.229	0.260	0.260	0.360	0.520
		Orig Segment Directional Closure Extent (direction 2)	0.000	0.000	1.375	0.067	0.200	0.160	0.160	0.040	0.360
		Segment Closures with fatalities/injuries	11	11	58	30	15	6	6	9	22
		Total Segment Closures	12	12	60	32	15	17	17	10	22
		% Closures with Fatality/Injury	0.92	0.92	0.97	0.94	1.00	0.35	0.35	0.90	1.00
		Closure Reduction	0.070	0.027	0.180	0.210	0.384	0.152	0.172	0.183	0.228
		Closure Reduction Factor	0.930	0.973	0.820	0.790	0.616	0.848	0.828	0.817	0.772
		Post-Project Segment Directional Closure Extent (direction 1)	0.345	0.362	0.103	0.509	0.141	0.221	0.215	0.294	0.401
		Post-Project Segment Directional Closure Extent (direction 2)	0.000	0.000	1.128	0.053	0.123	0.136	0.132	0.033	0.278
	BICYCLE ACCOM	Orig Segment Bicycle Accomodation %	22.0%	22.0%	1.0%	0.0%	74.0%	100.0%	100.0%	98.0%	98.0%
		Orig Segment Outside Shoulder width	3.3	3	1.6	0.0	8.9	9.5	9.5	9.5	9.9
		Post-Project Segment Outside Shoulder width	3.7	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Post-Project Segment Bicycle Accomodation (%)	22.6%	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Post-Project Segment Bicycle Accomodation (%)	22.6%	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
	Needs	Original Segment Mobility Need	2.258	2.258	4.178	9.162	0.857	0.773	0.773	0.374	0.559
		Post-Project Segment Mobility Need	1.731	2.250	3.062	7.107	0.826	0.593	0.569	0.353	0.461

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Direction 1 = NB/EB
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		Solution #	CS95N.1 A	CS95N.1 B	CS95N.2	CS95N.3	CS68.4	CS68.5A	CS68.5B	CS68.6	CS68.7
		Description	Arizona Village Area Safety and Mobility Improvements - Opiton A	Arizona Village Area Safety and Mobility Improvements - Option B	Fort Mohave Area Safety and Mobility Improvements	Bullhead City Area Safety, Mobility, and Freight Improvements	Sunridge Area Safety Improvements	Black Mountains Area Safety and Freight Improvements	Black Mountains Area Safety and Freight Improvements	West Golden Valley Area Safety and Freight Improvements	East Golden Valley Area Safety Improvements
		Project Beg MP	226.1	226.1	233	241	0	7	7	17	22
		Project End MP	227.3	227.3	241	249.8	7	17	17	22	27
		Project Length (miles)	1.2	1.2	3.90	8.50	5.7	2.5	2.5	5.20	4.80
		Segment Beg MP	226	226	233	241	0	7	7	17	22
		Segment End MP	233	233	241	250	7	17	17	22	27
		Segment Length (miles)	7	7	8	9	7	10	10	5	5
		Segment #	95N-1	95N-1	95N-2	95N-3	68-4	68-5	68-5	68-6	68.7
		Current # of Lanes (both directions)	2	2	4	4	4	4	4	4	4
		Project Type (one-way or two-way)	two-way	two-way	two-way	two-way	two-way	two-way	two-way	two-way	two-way
		Additional Lanes (one-way)	1	0	0	0	0	0	0	0	0
		Pro-Rated # of Lanes	2.34	2.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
		Description									
FREIGHT	TTTI AND TPTI	Mobility effect on TTTI	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
		Mobility effect on TPTI	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
		Safety effect on TTTI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Safety effect on TPTI	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
		Original Directional Segment TTTI (direction 1)	1.084	1.084	1.299	1.564	1.265	1.273	1.273	1.051	1.000
		Original Directional Segment TPTI (direction 1)	2.157	2.157	4.314	7.003	2.202	2.046	2.046	1.465	1.242
		Original Directional Segment TTTI (direction 2)	1.046	1.046	1.270	1.606	1.235	1.012	1.012	1.000	1.000
		Original Directional Segment TPTI (direction 2)	1.615	1.615	3.928	7.321	5.106	2.444	2.444	1.706	1.450
		Reduction Factor for Segment TTTI (both directions)	0.014	0.000	0.013	0.020	0.000	0.000	0.000	0.000	0.000
		Reduction Factor for Segment TPTI (both directions)	0.021	0.004	0.037	0.047	0.058	0.065	0.073	0.031	0.034
		Post-Project Directional Segment TTTI (direction 1)	1.069	1.084	1.282	1.532	1.265	1.273	1.273	1.051	1.000
		Post-Project Directional Segment TPTI (direction 1)	2.113	2.148	4.155	6.672	2.075	1.914	1.896	1.420	1.200
		Post-Project Directional Segment TTTI (direction 2)	1.032	1.046	1.253	1.573	1.235	1.012	1.012	1.000	1.000
		Post-Project Directional Segment TPTI (direction 2)	1.581	1.608	3.783	6.975	4.812	2.286	2.265	1.654	1.401
	FREIGHT INDEX	Original Segment TPTI (direction 1)	2.157	2.157	4.314	7.003	2.202	2.046	2.046	1.465	1.242
		Original Segment TPTI (direction 2)	1.615	1.615	3.928	7.321	5.106	2.444	2.444	1.706	1.450
		Original Segment Freight Index	0.530	0.530	0.243	0.140	0.274	0.446	0.446	0.631	0.743
		Post-Project Segment TPTI (direction 1)	2.113	2.148	4.155	6.672	2.075	1.914	1.896	1.420	1.200
		Post-Project Segment TPTI (direction 2)	1.581	1.608	3.783	6.975	4.812	2.286	2.265	1.654	1.401
		Post-Project Segment Freight Index	0.541	0.533	0.252	0.147	0.290	0.476	0.481	0.651	0.769
	CLOSURE DURATION	Orig Segment Directional Closure Duration (dir 1)	42.314	42.314	15.850	55.889	34.114	44.420	44.420	128.680	59.800
		Orig Segment Directional Closure Duration (dir 2)	0.000	0.000	226.250	4.533	34.000	35.240	35.240	3.560	43.520
		Segment Closures with fatalities	11	11	58	30	15	6	6	9	22
		Total Segment Closures	12	12	60	32	15	17	17	10	22
		% Closures with Fatality	0.92	0.92	0.97	0.94	1.00	0.35	0.35	0.90	1.00
		Closure Reduction	0.070	0.027	0.180	0.210	0.384	0.152	0.172	0.183	0.228
		Closure Reduction Factor	0.930	0.973	0.820	0.790	0.616	0.848	0.828	0.817	0.772
		Post-Project Segment Directional Closure Duration (direction 1)	39.337	41.192	13.002	44.127	21.028	37.677	36.760	105.083	46.142
		Post-Project Segment Directional Closure Duration (direction 2)	0.000	0.000	185.591	3.579	20.957	29.891	29.163	2.907	33.580
	VERT CLR	Original Segment Vertical Clearance	No UP	No UP	No UP	No UP	No UP	No UP	No UP	No UP	No UP
		Original vertical clearance for specific bridge	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Post-Project vertical clearance for specific bridge	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Post-Project Segment Vertical Clearance	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Post-Project Segment Vertical Clearance	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
	Needs	Original Segment Freight Need	0.146	0.146	1.752	2.988	0.869	4.571	4.571	3.337	0.818
		Post-Project Segment Freight Need	0.143	0.145	1.480	2.848	0.704	4.297	4.260	2.981	0.542

LEGEND:

-user entered value

-calculated value for reference

-calculated value for use in other spreadsheet

-for input into PES spreadsheet

-assumed values

Direction 1 = NB/EB

Direction 2 = SB/WB

		Description	Solution #	CS95N.1 A Arizona Village Area Safety and Mobility Improvements - Opiton A	CS95N.1 B Arizona Village Area Safety and Mobility Improvements - Option B	CS95N.2 Fort Mohave Area Safety and Mobility Improvements	CS95N.3 Bullhead City Area Safety, Mobility, and Freight Improvements	CS68.4 Sunridge Area Safety Improvements	CS68.5A Black Mountains Area Safety and Freight Improvements	CS68.5B Black Mountains Area Safety and Freight Improvements	CS68.6 West Golden Valley Area Safety and Freight Improvements	CS68.7 East Golden Valley Area Safety Improvements
			Project Beg MP	226.1	226.1	233	241	0	7	7	17	22
			Project End MP	227.3	227.3	241	249.8	7	17	17	22	27
			Project Length (miles)	1.2	1.2	3.90	8.50	5.7	2.5	2.5	5.20	4.80
			Segment Beg MP	226	226	233	241	0	7	7	17	22
			Segment End MP	233	233	241	250	7	17	17	22	27
			Segment Length (miles)	7	7	8	9	7	10	10	5	5
			Segment #	95N-1	95N-1	95N-2	95N-3	68-4	68-5	68-5	68-6	68.7
			Current # of Lanes (both directions)	2	2	4	4	4	4	4	4	4
			Project Type (one-way or two-way)	two-way	two-way	two-way	two-way	two-way	two-way	two-way	two-way	two-way
			Additional Lanes (one-way)	1	0	0	0	0	0	0	0	0
			Pro-Rated # of Lanes	2.34	2.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
		Description										
BRIDGE	BRIDGE INDEX	Original Segment Bridge Index		No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Original lowest rating for specific bridge		No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Post-Project lowest rating for specific bridge		No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Post-Project lowest rating for specific bridge		No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Post-Project Segment Bridge Index		No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Post-Project Segment Bridge Index		No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
	SUFF RATING	Original Segment Sufficiency Rating		No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Original Sufficiency Rating for specific bridge		No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Post-Project Sufficiency Rating for specific bridge		No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Post-Project Sufficiency Rating for specific bridge		No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Post-Project Segment Sufficiency Rating		No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Post-Project Segment Sufficiency Rating		No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
	BR RTNG	Original Segment Bridge Rating		No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Post-Project Segment Bridge Rating		No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Post-Project Segment Bridge Rating		No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
	% FUN OB	Original Segment % Functionally Obsolete		No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Post-Project Segment % Functionally Obsolete		No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Post-Project Segment % Functionally Obsolete		No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
	Needs	Original Segment Bridge Need		No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Post-Project Segment Bridge Need		No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
PAVEMENT	PAVEMENT INDEX	Original Segment Pavement Index		3.555	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Original Segment IRI in project limits		95.609	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Original Segment Cracking in project limits		2	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Post-Project IRI in project limits		30	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Post-Project IRI in project limits		30	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Post-Project Cracking in project limits		0	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Post-Project Cracking in project limits		0	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Post-Project Segment Pavement Index		3.692	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Post-Project Segment Pavement Index		3.692	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
	DIRECTION PSR	Original Segment Directional PSR (direction 1)		3.327	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Original Segment Directional PSR (direction 2)		3.327	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Original Segment IRI in project limits		95.609	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Post-Project directional IRI in project limits		30	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Post-Project Segment Directional PSR (direction 1)		3.478	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Post-Project Segment Directional PSR (direction 2)		3.478	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Post-Project Segment Directional PSR (direction 1)		3.478	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Post-Project Segment Directional PSR (direction 2)		3.478	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
	% FAIL	Original Segment % Failure		15.4%	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Post-Project Segment % Failure		14.3%	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Post-Project Segment % Failure		14.3%	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
	Needs	Original Segment Pavement Need		0.394	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Post-Project Segment Pavement Need		0.282	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change

CMF Application

SR 68/SR 95N Corridor Profile Study
CMF Application

=user input

CS95N.1 - Option A (MP 226.1-227.3)

BMP	EMP	CMF1	CMF2	CMF3	CMF4	Dir	Effective CMF	Crashes in Segment Limits Fatal	Crashes in Segment Limits Incap	Crashes in Solution Limits Fatal	Crashes in Solution Limits Incap	Post-Solution Crashes Fatal	Post-Solution Crashes Incap	Crash Reduction Fatal	Crash Reduction Incap
226.1	227.3	0.60	0.83	1	1	NB/EB	0.549			0	1	0.000	0.549	0.000	0.451
226.1	227.3	0.60	0.83	1	1	SB/WB	0.549			0	3	0.000	1.647	0.000	1.353
						NB/EB		0	2	0	1	**0.000**	**1.549**	0.000	0.451
						SB/WB		1	7	0	3	**1.000**	**5.647**	0.000	1.353

CS95N.1 - Option B (MP 226.1-227.3)

BMP	EMP	CMF1	CMF2	CMF3	CMF4	Dir	Effective CMF	Crashes in Segment Limits Fatal	Crashes in Segment Limits Incap	Crashes in Solution Limits Fatal	Crashes in Solution Limits Incap	Post-Solution Crashes Fatal	Post-Solution Crashes Incap	Crash Reduction Fatal	Crash Reduction Incap
226.1	227.3	0.83	1	1	1	NB/EB	0.830			0	1	0.000	0.830	0.000	0.170
226.1	227.3	0.83	1	1	1	SB/WB	0.830			0	3	0.000	2.490	0.000	0.510
						NB/EB		0	2	0	1	**0.000**	**1.830**	0.000	0.170
						SB/WB		1	7	0	3	**1.000**	**6.490**	0.000	0.510

CS95N.2 (MP 233-241)

BMP	EMP	CMF1	CMF2	CMF3	CMF4	Dir	Effective CMF	Crashes in Segment Limits Fatal	Crashes in Segment Limits Incap	Crashes in Solution Limits Fatal	Crashes in Solution Limits Incap	Post-Solution Crashes Fatal	Post-Solution Crashes Incap	otal Crash Reductio Fatal	Crash Reduction Incap
234.4 (Boundary Cone Rd)		0.85	0.90	1	1	NB/EB	0.808			0	1	0.000	0.808	0.000	0.193
234.4 (Boundary Cone Rd)		0.85	0.90	1	1	SB/WB	0.808			0	1	0.000	0.808	0.000	0.193
234.4	235.0	0.90	1	1	1	NB/EB	0.900			0	2	0.000	1.800	0.000	0.200
234.4	235.0	0.90	1	1	1	SB/WB	0.900			0	0	0.000	0.000	0.000	0.000
236.2 (Chaparral Rd)		0.83	0.89	0.9	0.95	NB/EB	0.727			1	3	0.727	2.180	0.273	0.820
236.2 (Chaparral Rd)		0.83	0.89	0.9	0.95	SB/WB	0.727			0	0	0.000	0.000	0.000	0.000
235.0	237.1	0.83	0.89	0.9	1	NB/EB	0.745			0	2	0.000	1.490	0.000	0.510
235.0	237.1	0.83	0.89	0.9	1	SB/WB	0.745			0	3	0.000	2.235	0.000	0.765
235.0	237.1	0.75	0.83	0.89	0.9	NB/EB	0.616			0	1	0.000	0.616	0.000	0.384
235.0	237.1	0.75	0.83	0.89	0.9	SB/WB	0.616			0	0	0.000	0.000	0.000	0.000
235.0	237.1	0.24	0.83	0.89	0.9	NB/EB	0.197			0	0	0.000	0.000	0.000	0.000
235.0	237.1	0.24	0.83	0.89	0.9	SB/WB	0.197			0	1	0.000	0.197	0.000	0.803
237.1	237.4	0.90	1	1	1	NB/EB	0.900			1	1	0.900	0.900	0.100	0.100
237.1	237.4	0.90	1	1	1	SB/WB	0.900			0	1	0.000	0.900	0.000	0.100
237.4 (El Rodeo Dr)		0.85	0.90	1	1	NB/EB	0.808			0	3	0.000	2.423	0.000	0.578
237.4 (El Rodeo Dr)		0.75	0.85	0.9	1	SB/WB	0.659			0	2	0.000	1.318	0.000	0.682
237.4	238.9	0.90	1	1	1	NB/EB	0.900			2	9	1.800	8.100	0.200	0.900
237.4	238.9	0.90	1	1	1	SB/WB	0.900			1	15	0.900	13.500	0.100	1.500
238.9	239.5	0.75	0.83	0.89	0.90	NB/EB	0.616			1	0	0.616	0.000	0.384	0.000
238.9	239.5	0.75	0.83	0.89	0.90	SB/WB	0.616			0	1	0.000	0.616	0.000	0.384
238.9	239.5	0.24	0.83	0.89	0.90	NB/EB	0.500			0	1	0.000	0.500	0.000	0.500
238.9	239.5	0.24	0.83	0.89	0.90	SB/WB	0.500			0	0	0.000	0.000	0.000	0.000
239.5	240.7	0.83	0.89	0.9	1	NB/EB	0.745			0	1	0.000	0.745	0.000	0.255
239.5	240.7	0.83	0.89	0.9	1	SB/WB	0.745			1	0	0.745	0.000	0.255	0.000
239.9 (Corwin Rd)		0.83	0.89	0.90	0.95	NB/EB	0.727			0	1	0.000	0.727	0.000	0.273
239.9 (Corwin Rd)		0.83	0.89	0.90	0.95	SB/WB	0.727			0	0	0.000	0.000	0.000	0.000
						NB/EB		5	26	5	25	**4.043**	**21.287**	0.957	4.713
						SB/WB		2	24	2	24	**1.645**	**19.574**	0.355	4.426

CMF Application =user input

CS95N.3 (MP 241-250)

BMP	EMP	CMF1	CMF2	CMF3	CMF4	Dir	Effective CMF	Crashes in Segment Limits Fatal	Crashes in Segment Limits Incap	Crashes in Solution Limits Fatal	Crashes in Solution Limits Incap	Post-Solution Crashes Fatal	Post-Solution Crashes Incap	Total Crash Reductio Fatal	Total Crash Reductio Incap
240.7	249.5	0.83	0.90	1	1	NB/EB	0.789			1	9	0.789	7.097	0.212	1.904
240.7	249.5	0.83	0.90	1	1	SB/WB	0.789			7	11	5.520	8.674	1.481	2.327
249.5	249.8	0.90	1	1	1	NB/EB	0.900			0	0	0.000	0.000	0.000	0.000
249.5	249.8	0.90	1	1	1	SB/WB	0.900			0	0	0.000	0.000	0.000	0.000
242.8 (Mohave Dr)		0.83	0.85	0.90	1	NB/EB	0.729			0	1	0.000	0.729	0.000	0.271
242.8 (Mohave Dr)		0.83	0.85	0.90	1	SB/WB	0.729			1	0	0.729	0.000	0.271	0.000
~~243.9~~		~~1~~	~~1~~	~~1~~	~~1~~	~~NB/EB~~	~~1.000~~			~~0~~	~~0~~	~~0.000~~	~~0.000~~	~~0.000~~	~~0.000~~
243.9 (Marina Blvd)		0.81	0.83	0.90	1	SB/WB	0.704			1	0	0.704	0.000	0.296	0.000
~~244.2~~		~~1~~	~~1~~	~~1~~	~~1~~	~~NB/EB~~	~~1.000~~			~~0~~	~~0~~	~~0.000~~	~~0.000~~	~~0.000~~	~~0.000~~
244.2 (Thunderstruck Dr)		0.81	0.83	0.90	1	SB/WB	0.704			0	0	0.000	0.000	0.000	0.000
244.3 (Hancock Rd)		0.83	0.88	0.90	1	NB/EB	0.741			0	2	0.000	1.482	0.000	0.518
244.3 (Hancock Rd)		0.83	0.88	0.90	1	SB/WB	0.741			0	2	0.000	1.482	0.000	0.518
244.9 (Ramar Rd)		0.83	0.85	0.90	1	NB/EB	0.729			0	1	0.000	0.729	0.000	0.271
244.9 (Ramar Rd)		0.83	0.85	0.90	1	SB/WB	0.729			0	1	0.000	0.729	0.000	0.271
						NB/EB		1	14	1	13	**0.789**	**11.038**	0.212	2.962
						SB/WB		9	14	9	14	**6.953**	**10.885**	2.047	3.115

CS68.4 (MP 0-7)

BMP	EMP	CMF1	CMF2	CMF3	CMF4	Dir	Effective CMF	Crashes in Segment Limits Fatal	Crashes in Segment Limits Incap	Crashes in Solution Limits Fatal	Crashes in Solution Limits Incap	Post-Solution Crashes Fatal	Post-Solution Crashes Incap	Total Crash Reductio Fatal	Total Crash Reductio Incap
0.0	0.6	0.77	1	1	1	NB/EB	0.770			0	0	0.000	0.000	0.000	0.000
0.0	0.6	0.77	1	1	1	SB/WB	0.770			0	0	0.000	0.000	0.000	0.000
0.6	0.9	0.77	0.79	0.83	1	NB/EB	0.631			0	1	0.000	0.631	0.000	0.369
0.6	0.9	0.77	0.79	0.83	1	SB/WB	0.631			0	0	0.000	0.000	0.000	0.000
0.9	1.3	0.77	1	1	1	NB/EB	0.770			0	1	0.000	0.770	0.000	0.230
0.9	1.3	0.77	1	1	1	SB/WB	0.770			0	0	0.000	0.000	0.000	0.000
1.3	2.1	0.72	1	1	1	NB/EB	0.720			0	0	0.000	0.000	0.000	0.000
1.3	2.1	0.72	1	1	1	SB/WB	0.720			0	0	0.000	0.000	0.000	0.000
2.1	2.6	0.72	0.75	0.83	1	NB/EB	0.576			1	0	0.576	0.000	0.424	0.000
2.1	2.6	0.72	0.75	0.83	1	SB/WB	0.576			0	0	0.000	0.000	0.000	0.000
2.6	3.0	1	1	1	1	NB/EB	1.000			0	0	0.000	0.000	0.000	0.000
2.6	3.0	1	1	1	1	SB/WB	1.000			0	0	0.000	0.000	0.000	0.000
3.0	4.1	0.72	1	1	1	NB/EB	0.720			0	1	0.000	0.720	0.000	0.280
3.0	4.1	0.72	1	1	1	SB/WB	0.720			0	0	0.000	0.000	0.000	0.000
4.1	4.6	0.77	0.79	0.83	1	NB/EB	0.631			0	0	0.000	0.000	0.000	0.000
4.1	4.6	0.77	0.79	0.83	1	SB/WB	0.631			0	0	0.000	0.000	0.000	0.000
4.6	6.5	0.72	1	1	1	NB/EB	0.720			0	1	0.000	0.720	0.000	0.280
4.6	6.5	0.72	1	1	1	SB/WB	0.720			0	0	0.000	0.000	0.000	0.000
6.5	6.9	0.77	0.79	0.83	1	NB/EB	0.631			0	0	0.000	0.000	0.000	0.000
6.5	6.9	0.77	0.79	0.83	1	SB/WB	0.631			1	0	0.631	0.000	0.369	0.000
6.9	7.0	0.72	1	1	1	NB/EB	0.720			0	0	0.000	0.000	0.000	0.000
6.9	7.0	0.72	1	1	1	SB/WB	0.720			0	0	0.000	0.000	0.000	0.000
						NB/EB		1	4	1	4	**0.576**	**2.841**	0.424	1.159
						SB/WB		1	0	1	0	**0.631**	**0.000**	0.369	0.000

SR 68/SR 95N Corridor Profile Study

CMF Application =user input

CS68.5A (MP 7-17)

BMP	EMP	CMF1	CMF2	CMF3	CMF4	Dir	Effective CMF	Crashes in Segment Limits Fatal	Crashes in Segment Limits Incap	Crashes in Solution Limits Fatal	Crashes in Solution Limits Incap	Post-Solution Crashes Fatal	Post-Solution Crashes Incap	Total Crash Reductio Fatal	Total Crash Reductio Incap
7.0	8.6	0.72	1	1	1	NB/EB	0.720			0	1	0.000	0.720	0.000	0.280
7.0	8.6	0.72	1	1	1	SB/WB	0.720			0	0	0.000	0.000	0.000	0.000
8.6	9.1	0.72	0.79	0.81	0.94	NB/EB	0.566			2	2	1.131	1.131	0.869	0.869
8.6	9.1	0.72	0.79	0.81	0.94	SB/WB	0.566			1	0	0.566	0.000	0.434	0.000
9.1	10.6	0.72	0.81	1	1	NB/EB	0.652			0	0	0.000	0.000	0.000	0.000
9.1	10.6	0.72	0.81	1	1	SB/WB	0.652			0	0	0.000	0.000	0.000	0.000
10.6	11.1	0.72	0.79	0.81	0.94	NB/EB	0.566			0	1	0.000	0.566	0.000	0.434
10.6	11.1	0.72	0.79	0.81	0.94	SB/WB	0.566			4	0	2.263	0.000	1.737	0.000
11.1	17.0	0.72	1	1	1	NB/EB	0.720			0	2	0.000	1.440	0.000	0.560
11.1	17.0	0.72	1	1	1	SB/WB	0.720			0	0	0.000	0.000	0.000	0.000
						NB/EB		2	6	2	6	**1.131**	**3.857**	0.869	2.143
						SB/WB		5	0	5	0	**2.828**	**0.000**	2.172	0.000

CS68.5B (MP 7-17)

BMP	EMP	CMF1	CMF2	CMF3	CMF4	Dir	Effective CMF	Crashes in Segment Limits Fatal	Crashes in Segment Limits Incap	Crashes in Solution Limits Fatal	Crashes in Solution Limits Incap	Post-Solution Crashes Fatal	Post-Solution Crashes Incap	Total Crash Reductio Fatal	Total Crash Reductio Incap
7.0	8.6	0.72	1	1	1	NB/EB	0.720			0	1	0.000	0.720	0.000	0.280
7.0	8.6	0.72	1	1	1	SB/WB	0.720			0	0	0.000	0.000	0.000	0.000
8.6	9.1	0.72	0.79	0.9	0.94	NB/EB	0.594			2	2	0.594	1.188	1.406	0.812
8.6	9.1	0.72	0.79	0.9	0.94	SB/WB	0.594			1	0	0.594	0.000	0.406	0.000
9.1	10.6	0.72	0.9	1	1	NB/EB	0.684			0	0	0.000	0.000	0.000	0.000
9.1	10.6	0.72	0.9	1	1	SB/WB	0.684			0	0	0.000	0.000	0.000	0.000
10.6	11.1	0.72	0.79	0.9	0.94	NB/EB	0.594			0	1	0.000	0.000	0.000	1.000
10.6	11.1	0.72	0.79	0.9	0.94	SB/WB	0.594			4	0	2.375	0.000	1.625	0.000
11.1	17.0	0.72	1	1	1	NB/EB	0.720			0	2	0.000	1.440	0.000	0.560
11.1	17.0	0.72	1	1	1	SB/WB	0.720			0	0	0.000	0.000	0.000	0.000
						NB/EB		2	6	2	6	**0.594**	**3.348**	1.406	2.652
						SB/WB		5	0	5	0	**2.969**	**0.000**	2.031	0.000

SR 68/SR 95N Corridor Profile Study

CMF Application =user input

CS68.6 (MP 17-22)

BMP	EMP	CMF1	CMF2	CMF3	CMF4	Dir	Effective CMF	Crashes in Segment Limits Fatal	Crashes in Segment Limits Incap	Crashes in Solution Limits Fatal	Crashes in Solution Limits Incap	Post-Solution Crashes Fatal	Post-Solution Crashes Incap	Total Crash Reductio Fatal	Total Crash Reductio Incap
16.8 (Egar Rd)		0.80	1	1	1	NB/EB	0.800			0	0	0.000	0.000	0.000	0.000
16.8 (Egar Rd)		0.80	1	1	1	SB/WB	0.800			0	0	0.000	0.000	0.000	0.000
17.8 (Estrella Rd)		0.80	1	1	1	NB/EB	0.800			0	0	0.000	0.000	0.000	0.000
17.8 (Estrella Rd)		0.80	1	1	1	SB/WB	0.800			1	2	0.800	1.600	0.200	0.400
16.8	17.8	0.83	1	1	1	NB/EB	0.830			1	1	0.830	0.830	0.170	0.170
16.8	17.8	0.83	1	1	1	SB/WB	0.830			0	0	0.000	0.000	0.000	0.000
18.7 (Milky Way Rd)		0.87	1	1	1	NB/EB	0.870			0	0	0.000	0.000	0.000	0.000
18.7 (Milky Way Rd)		0.87	1	1	1	SB/WB	0.870			0	2	0.000	1.740	0.000	0.260
19.8 (Teddy Roosevelt Road)		0.80	1	1	1	NB/EB	0.800			2	0	1.600	0.000	0.400	0.000
19.8 (Teddy Roosevelt Road)		0.80	1	1	1	SB/WB	0.800			0	1	0.000	0.800	0.000	0.200
20.8 (Colorado Rd)		0.40	0.75	1	1	NB/EB	0.350			0	1	0.000	0.350	0.000	0.650
20.8 (Colorado Rd)		0.40	0.75	1	1	SB/WB	0.350			0	0	0.000	0.000	0.000	0.000
21.8 (Verde Rd)		0.40	1	1	1	NB/EB	0.400			0	1	0.000	0.400	0.000	0.600
21.8 (Verde Rd)		0.40	1	1	1	SB/WB	0.400			0	0	0.000	0.000	0.000	0.000
20.8	22.0	0.83	1	1	1	NB/EB	0.830			0	0	0.000	0.000	0.000	0.000
20.8	22.0	0.83	1	1	1	SB/WB	0.830			0	0	0.000	0.000	0.000	0.000
						NB/EB		3	3	3	3	**2.430**	**1.580**	0.570	1.420
						SB/WB		1	5	1	5	**0.800**	**4.140**	0.200	0.860

CS68.7 (MP 22-27)

BMP	EMP	CMF1	CMF2	CMF3	CMF4	Dir	Effective CMF	Crashes in Segment Limits Fatal	Crashes in Segment Limits Incap	Crashes in Solution Limits Fatal	Crashes in Solution Limits Incap	Post-Solution Crashes Fatal	Post-Solution Crashes Incap	Total Crash Reductio Fatal	Total Crash Reductio Incap
22.0	26.8	0.83	1	1	1	NB/EB	0.830			1	2	0.830	1.660	0.170	0.340
22.0	26.8	0.83	1	1	1	SB/WB	0.830			1	0	0.830	0.000	0.170	0.000
23.7	24.9	0.75	0.83	1	1	NB/EB	0.686			1	1	0.686	0.686	0.314	0.314
23.7	24.9	0.75	0.83	1	1	SB/WB	0.686			1	0	0.686	0.000	0.314	0.000
23.7	24.9	0.83	1	1	1	NB/EB	0.830			0	1	0.000	0.830	0.000	0.170
23.7	24.9	0.83	1	1	1	SB/WB	0.830			0	1	0.000	0.830	0.000	0.170
25.3	26.7	0.75	0.83	1	1	NB/EB	0.686			0	0	0.000	0.000	0.000	0.000
25.3	26.7	0.75	0.83	1	1	SB/WB	0.686			1	0	0.686	0.000	0.314	0.000
25.3	26.7	0.83	1	1	1	NB/EB	0.830			2	1	1.660	0.830	0.340	0.170
25.3	26.7	0.83	1	1	1	SB/WB	0.830			1	1	0.830	0.830	0.170	0.170
22.8 (Adobe Rd)		0.40	1	1	1	NB/EB	0.400			0	0	0.000	0.000	0.000	0.000
22.8 (Adobe Rd)		0.40	1	1	1	SB/WB	0.400			0	1	0.000	0.400	0.000	0.600
23.8 (Aztec Rd)		0.40	1	1	1	NB/EB	0.400			0	1	0.000	0.400	0.000	0.600
23.8 (Aztec Rd)		0.40	1	1	1	SB/WB	0.400			0	0	0.000	0.000	0.000	0.000
24.8 (Bacobi Rd)		0.40	1	1	1	NB/EB	0.400			0	0	0.000	0.000	0.000	0.000
24.8 (Bacobi Rd)		0.40	1	1	1	SB/WB	0.400			0	0	0.000	0.000	0.000	0.000
						NB/EB		4	6	4	6	**3.176**	**4.406**	0.824	1.594
						SB/WB		4	3	4	3	**3.033**	**2.060**	0.968	0.940

Performance Area Scoring

Candidate Solution #	Candidate Solution Name	Milepost Location	Estimated Cost ($ millions)	Pavement					Bridge					Safety					Mobility					Freight					Total Risk Factored Performance Area Benefit
				Existing Segment Need	Post-Solution Segment Need	Raw Score	Risk Factor	Factored Score	Existing Segment Need	Post-Solution Segment Need	Raw Score	Risk Factor	Factored Score	Existing Segment Need	Post-Solution Segment Need	Raw Score	Risk Factor	Factored Score	Existing Segment Need	Post-Solution Segment Need	Raw Score	Risk Factor	Factored Score	Existing Segment Need	Post-Solution Segment Need	Raw Score	Risk Factor	Factored Score	
CS95N.1A	Arizona Village Area Safety and Mobility Improvements - Option A	226-227	5.9	0.394	0.282	0.112	2.55	0.285	2.911	2.911	0.000	0.00	0.000	0.959	0.883	0.076	4.75	0.362	2.258	1.731	0.527	3.23	1.700	0.146	0.143	0.004	3.79	0.014	2.361
CS95N.1B	Arizona Village Area Safety and Mobility Improvements - Option B	226-227	1.1	0.394	0.394	0.000	0.00	0.000	2.911	2.911	0.000	0.00	0.000	0.959	0.931	0.028	4.75	0.134	2.258	2.250	0.008	3.23	0.025	0.146	0.145	0.001	3.79	0.005	0.165
CS95N.2	Fort Mohave Area Safety and Mobility Improvements	234-241	10.9	2.007	2.007	0.000	0.00	0.000	0.000	0.000	0.000	0.00	0.000	7.507	5.818	1.689	5.17	8.726	4.178	3.062	1.116	2.58	2.882	1.752	1.480	0.272	2.39	0.650	12.258
CS95N.3	Bullhead City Area Safety, Mobility, and Freight Improvements	241-250	10.4	0.738	0.738	0.000	0.00	0.000	3.035	3.035	0.000	0.00	0.000	6.879	5.017	1.862	5.32	9.896	5.545	4.057	1.488	4.52	6.730	2.988	2.848	0.140	3.04	0.425	17.051
CS68.4	Sunridge Area Safety Improvements	0-7	5.1	0.000	0.000	0.000	0.00	0.000	0.500	0.500	0.000	0.00	0.000	2.935	1.448	1.487	3.94	5.865	0.857	0.826	0.031	4.40	0.135	0.869	0.704	0.165	4.14	0.682	6.682
CS68.5A	Black Mountains Area Safety and Freight Improvements	7-17	5.6	0.012	0.012	0.000	0.00	0.000	0.125	0.125	0.000	0.00	0.000	8.851	4.277	4.574	2.41	11.018	0.773	0.593	0.180	5.59	1.008	4.571	4.297	0.273	5.80	1.587	13.613
CS68.5B	Black Mountains Area Safety and Freight Improvements	7-17	9.1	0.012	0.012	0.000	0.00	0.000	0.125	0.125	0.000	0.00	0.000	8.851	3.434	5.417	2.41	13.049	0.773	0.569	0.204	5.59	1.143	4.571	4.260	0.311	5.80	1.803	15.995
CS68.6	West Golden Valley Area Safety and Freight Improvements	17-22	20.2	0.108	0.108	0.000	0.00	0.000	0.184	0.184	0.000	0.00	0.000	9.950	7.563	2.387	0.80	1.920	0.374	0.353	0.021	2.67	0.055	3.337	2.981	0.356	3.47	1.236	3.210
CS68.7	East Golden Valley Area Safety Improvements	22-27	19.8	0.000	0.000	0.000	0.00	0.000	0.500	0.500	0.000	0.00	0.000	14.142	10.552	3.590	0.76	2.727	0.559	0.461	0.098	5.07	0.498	0.818	0.542	0.276	5.34	1.473	4.698

Performance Effectiveness Scoring

Candidate Solution #	Candidate Solution Name	Milepost Location	Estimated Cost ($ millions)	Safety Emphasis Area						Pavement Emphasis Area						Mobility Emphasis Area						Total Factored Benefit	VMT Factor	NPV Factor	Performance Effectiveness Score		miles	2015 ADT	1-way or 2 way	VMT
				Existing Corridor Need	Post-Solution Corridor Need	Raw Score	Risk Factor	Emphasis Factor	Factored Score	Existing Corridor Need	Post-Solution Corridor Need	Raw Score	Risk Factor	Emphasis Factor	Factored Score	Existing Corridor Need	Post-Solution Corridor Need	Raw Score	Risk Factor	Emphasis Factor	Factored Score									
CS95N.1A	Arizona Village Area Safety and Mobility Improvements - Option A	226-227	5.9	5.826	5.807	0.019	4.75	1.50	0.136	1.401	1.349	0.052	2.55	1.50	0.198	0.461	0.454	0.007	3.23	1.50	0.034	2.729	0.92	20.2	8.6		1.20	12256	2	14707.141
CS95N.1B	Arizona Village Area Safety and Mobility Improvements - Option B	226-227	1.1	5.826	5.819	0.007	4.75	1.50	0.051	1.401	1.401	0.000	0.00	1.50	0.000	0.461	0.461	0.000	3.23	1.50	0.000	0.216	0.92	20.2	3.7		1.20	12256	2	14707.141
CS95N.2	Fort Mohave Area Safety and Mobility Improvements	234-241	10.9	5.826	5.605	0.221	5.17	1.50	1.710	1.401	1.401	0.000	0.00	1.50	0.000	0.461	0.450	0.011	2.58	1.50	0.042	14.009	3.54	20.2	91.6		3.90	22671	2	88416.593
CS95N.3	Bullhead City Area Safety, Mobility, and Freight Improvements	241-250	10.4	5.826	5.546	0.280	5.32	1.50	2.229	1.401	1.401	0.000	0.00	1.50	0.000	0.461	0.441	0.020	4.52	1.50	0.135	19.415	4.81	20.2	181.6		8.50	27747	2	235845.87
CS68.4	Sunridge Area Safety Improvements	0-7	5.1	5.826	5.640	0.186	3.94	1.50	1.102	1.401	1.401	0.000	0.00	1.50	0.000	0.461	0.461	0.000	4.40	1.50	0.000	7.785	2.62	15.3	60.9		5.70	9351	2	53300.716
CS68.5A	Black Mountains Area Safety and Freight Improvements	7-17	5.6	5.826	5.080	0.746	2.41	1.50	2.694	1.401	1.401	0.000	0.00	1.50	0.000	0.461	0.461	0.000	5.59	1.50	0.000	16.308	1.18	15.3	53.0		2.50	7782	2	19455
CS68.5B	Black Mountains Area Safety and Freight Improvements	7-17	9.1	5.826	4.979	0.847	2.41	1.50	3.061	1.401	1.401	0.000	0.00	1.50	0.000	0.461	0.461	0.000	5.59	1.50	0.000	19.056	1.18	15.3	37.9		2.50	7782	2	19455
CS68.6	West Golden Valley Area Safety and Freight Improvements	17-22	20.2	5.826	5.631	0.195	0.80	1.50	0.235	1.401	1.401	0.000	0.00	1.50	0.000	0.461	0.461	0.000	2.67	1.50	0.000	3.445	2.40	20.2	8.3		5.20	9028	2	46945.6
CS68.7	East Golden Valley Area Safety Improvements	22-27	19.8	5.826	5.526	0.300	0.76	1.50	0.341	1.401	1.401	0.000	0.00	1.50	0.000	0.461	0.461	0.000	5.07	1.50	0.000	5.039	2.67	20.2	13.8		4.80	11468	2	55046.4

Appendix J: Solution Prioritization Scores

Candidate Solution #	Candidate Solution Name	Milepost Location	Estimated Cost ($ millions)	Pavement		Bridge		Safety		Mobility		Freight		Total Factored Score	Risk Factors					Weighted Risk Factor	Segment Need	Prioritization Score
				Score	%	Score	%	Score	%	Score	%	Score	%		Pavement	Bridge	Safety	Mobility	Freight			
CS95N.1A	Arizona Village Area Safety and Mobility Improvements - Option A	226-227	5.9	0.483	17.7%	0.000	0.0%	0.498	18.3%	1.734	63.5%	0.014	0.5%	2.729	1.14	1.51	1.78	1.36	1.36	1.398	1.38	**17**
CS95N.1B	Arizona Village Area Safety and Mobility Improvements - Option B	226-227	1.1	0.000	0.0%	0.000	0.0%	0.185	85.9%	0.025	11.6%	0.005	2.4%	0.216	1.14	1.51	1.78	1.36	1.36	1.721	1.38	**9**
CS95N.2	Fort Mohave Area Safety and Mobility Improvements	234-241	10.9	0.000	0.0%	0.000	0.0%	10.436	74.5%	2.924	20.9%	0.650	4.6%	14.009	1.14	1.51	1.78	1.36	1.36	1.673	2.00	**307**
CS95N.3	Bullhead City Area Safety, Mobility, and Freight Improvements	241-250	10.4	0.000	0.0%	0.000	0.0%	12.125	62.5%	6.865	35.4%	0.425	2.2%	19.415	1.14	1.51	1.78	1.36	1.36	1.622	2.54	**748**
CS68.4	Sunridge Area Safety Improvements	0-7	5.1	0.000	0.0%	0.000	0.0%	6.968	89.5%	0.135	1.7%	0.682	8.8%	7.785	1.14	1.51	1.78	1.36	1.36	1.736	1.08	**114**
CS68.5A	Black Mountains Area Safety and Freight Improvements	7-17	5.6	0.000	0.0%	0.000	0.0%	13.713	84.1%	1.008	6.2%	1.587	9.7%	16.308	1.14	1.51	1.78	1.36	1.36	1.713	1.38	**126**
CS68.5B	Black Mountains Area Safety and Freight Improvements	7-17	9.1	0.000	0.0%	0.000	0.0%	16.110	84.5%	1.143	6.0%	1.803	9.5%	19.056	1.14	1.51	1.78	1.36	1.36	1.715	1.38	**90**
CS68.6	West Golden Valley Area Safety and Freight Improvements	17-22	20.2	0.000	0.0%	0.000	0.0%	2.155	62.5%	0.055	1.6%	1.236	35.9%	3.445	1.14	1.51	1.78	1.36	1.36	1.623	1.62	**22**
CS68.7	East Golden Valley Area Safety Improvements	22-27	19.8	0.000	0.0%	0.000	0.0%	3.068	60.9%	0.498	9.9%	1.473	29.2%	5.039	1.14	1.51	1.78	1.36	1.36	1.616	1.08	**24**

Appendix K: Preliminary Scoping Reports for Prioritized Solutions

Appendix K will be provided in the Draft Final Report